Montgomery, Ala., Water Works.

Montgomery, the capital of Alabama is situated in the center of the State at head of navigation of Alabama river. High water in river is 162 feet above Gulf of Mexico. The population is 26,000.

The City Council contracted with A. H. Howland, Oct. 7, 1885 to build, maintain and operate a system of water works. Mr. Howland assigned his contract to The Capital City Water Company, and work was commenced at once.

The supply is derived from six 8-inch Artesian Wells having a combined capacity of about 5,000,000 gallons in twenty-four hours. Two of these wells are 635 feet deep, two 443 feet and two 280 feet, each of the three pairs of wells reaching to and deriving its supply from a different stratum, although the quality of the water is the same in each, and is exceptionally soft and pure, containing but 12.19 parts of solids in 100,000., 7.9 parts being sodium carbonate, the remaining parts being distributed, in small quantities, among five other simple and harmless substances. These wells discharge into two reservoirs having a combined capacity of three and one half million gallons; these reservoirs are made with earth embankments lined with masonry and divided, each from the other, with a masonry wall. The water is pumped from these reservoirs into the pipe distribution system and any surplus, which may be pumped in excess of the consumption, is delivered into a wrought-iron stand pipe or water tower.

The pumping machinery consists of one Duplex Compound Condensing Pumping Engine with a maximum daily capacity of 3,000,000 gallons of water, U. S. standard, also one Duplex High Pressure Pump Engine of the same capacity. The power for these pumping engines is supplied by six steel boilers of 80 horse power each. In addition to the above, are all of the usual and necessary air pumps, condensers, feed pumps, inspirators, etc. The entire pumping machinery was furnished by the Deane Steam Pump Co., of Holyoke, Mass.

The Pumping station is of brick, with iron truss roof, of neat and semi-ornamental design, two stories in height and covers a ground area of 80 feet in length and 50 feet in width, and is thoroughly fire proof in all particulars. The smoke stack is 105 feet in height and has 25 square feet of flue area.

The pipe distribution system, at present consists of twenty-five and one half miles of coated cast-iron water pipes of from 24 to 4 inches internal diameter, also 340 water gates of various sizes and 230 fire plugs for both private and public use; also all the usual and necessary special castings. The entire pipe system is planned to allow of future enlargement and extension, without cutting in for special castings or the change of any part of the system as at present laid down. The pipes and special castings were furnished by the Warren Foundry and Machine Co., of Phillipsburg, N. J., and by the Chattanooga Foundry and Pipe Works of Chattanooga, Tenn. The gates and hydrants were furnished by the Coffin Valve Co. of Boston, Mass.

The water tower or stand pipe, is 26 feet in internal diameter and 105 feet in height, it is made of heavy wrought-iron plates, having a tensile strength of 50,000 pounds of square inch of section. Encircling the stand pipe, from bottom to top, and around the top, is an ornamental iron stairway and balcony which together make one of the finest observatories in this section of the country. The total capacity of this stand pipe is 417,000 gallons, and it has a top elevation of 412 feet above the Gulf. This elevation gives a pressure in the business portion of the city of 110 pounds to the square inch and an average pressure in the residence portion of the city of eighty pounds to the square inch.

The works were completed July 1st, and soon after formally accepted by the city. The city pays an annual rental of $55 for each hydrant for fire purposes. Water is supplied to consumers at a rate of $6.00 per annum for first faucet, in a house of five rooms or less, and $1.00 per annum for each additional room. All parties using more than one faucet are supplied through Crown meters, at a uniform rate of 25 cents per 1,000 gallons, with a minimum rate of $10.00 per annum. Mr. Howland insisted that these meters should have "gallon" dials, instead of "cubic feet" dials, and this is the first works to adopt this style.

There are 500 taps at present, and the number is daily increasing.

The company was organized by Mr. Howland, and the works designed and built by him. The capital stock of the company is $300,000 with a bonded debt of $250,000. The officers are: President, W. F. Ellis, Ashland, Mass.; Treasurer and Engineer, A. H. Howland, Boston, Mass.; Superintendent, Travers Daniel, Montgomery; Secretary, Frank B. Bigelow, Montgomery. The first two, with W. B. Rice, of Boston, constitute the Board of Directors.

The Possible Motive Power of the Future.

During the last ten years M. Marcel Deprez, of Paris has been engaged in experiments connected with the transmission of force by means of electricity. The Rothschilds some time since provided him with an unlimited credit to prosecute his researches at Creil, under the inspection of a commission of 38 men of science. A few days ago the commission met to hear a report on the results at present obtained, drawn up, at their request by M. Maurice Levy. This report was unanimously approved. It appears from it that we can now, with only one generator and only one receptor, transport to a distance of about 35 miles a force capable of being used for industrial purposes of 52-horse power, with a yield of 45 per cent., without exceeding a current of 10 amperes. When the amount of force absorbed by the aparatus used to facilitate the recent experiment, but not required in the applications to industrial purposes, is added, the yield will be nearly 50 per cent.

The commission certifies that the machines now work regularly and continuously. The *maximum* electro-motive force is 6,290 volts. Before the construction of the Marcel Deprez aparatus the *maximum* force did not exceed 2,000 volts, The report states that this high tension does not give rise to any danger, and that no accident has occurred during the past six months. The commission is of opinion that the transmitting wire may be left uncovered on poles provided it be placed beyond the reach of the hand. It estimates at nearly £5,000 the probable cost of the transmission of 50-horse power round a circular line of about 70 miles. This price would, however, be much diminished if the machines were frequently constructed.

The commission, in the name of science and industry, warmly congratulated M. Deprez on the admirable results which he had obtained, and expressed thanks to the Rothschilds for the generous aid extended to the undertaking.

Kentucky's Turnpike System.

From the Staunton (Va.) Vindicator.

In conversation with Gen. Echols, who has traveled over most of Kentucky, a State whose good roads are now famous throughout the Union, we heard some interesting facts concerning the road improvements now general all over the State. The man who began the improvement there was that famous old Presbyterian Dr. Robert J. Breckinridge. He commenced by going to see his neighbors along a line of road. His plan was to ask each farmer: "How much is your land worth?" When told he would say: "Well, how much do you think a macadamized road would increase the value of it?" Being told $10 or $15 an acre, he would close in by saying: "Well, suppose you subscribe to a company we are forming to build a road to the amount of, say, $5 an acre of your farm." In this way private companies were formed. The roads cost $2,000 a mile, of which the County Court of each county, after it was satisfied that the private company was composed of responsible citizens, subscribed on behalf of the county to the stock to the amount of $1,000 a mile. The roads were built, toll gates put on them, and the stock paid the county and the stockholders a dividend. In this way Kentucky has become a ridironed with metal pikes. Now look at the result of this: Taking four counties in Kentucky, all rather small ones, Montgomery has 99 miles of metaled pike; Clarke, the adjoining county, has 150 miles; Fayette, which joins that, has 250 miles, and Barbour, the next county to it, has 300 miles—nearly 800 miles of macadamized road in four counties. What has been the result in increasing values? Remember, they are all small counties. The real estate in Montgomery is assessed at $4,000,000; Clarke, $6,000,000; Fayette, $8,000,000, and Barbour, $8,000,000. An increase of value which is the direct result of road building.

Municipal Engineering; Paper No. 3.*

WASHINGTON, D. C.

Description.—The District of Columbia is located on the north bank of the Potomac river, about 300 miles from the ocean by the river and Chesapeake bay. The latitude and longitude of the "National Observatory," which is the national prime meridian, is latitude 38° 53′, 39.42″, north and longitude 77° 02′, 48″, west. The District has an area of sixty-four square miles. The surface is quite rolling, rising from tide water to an elevation of nearly 400 feet in the northern part. The Potomac river flows along the southern and southwestern boundary of the District. Its principal tributaries in the District are the Anacostia, or eastern branch, which flows through the eastern part, and Rock creek, which flows through the western, and are both streams of considerable size. There are a number of small streams emptying into these, cutting out the surface into convenient sized drainage areas, and giving ample fall for thorough drainage, except in a small area near the river. The soil is generally light, rather sandy and gravelly, but with streaks and beds of clay affording abundant material for the manufacture of brick and terra cotta ware. The whole District is underlaid with gneiss, which comes to the surface in the western part. The climate has a range of temperature from about 105° Fahr. (in the shade) to—12°, but these extremes are rarely reached. Frost penetrates the ground to a depth of 2 feet at times, but usually not more than 1 foot. The average rainfall is about 40 inches per annum. There are usually one or more showers each summer in which the rainfall reaches or exceeds 2 inches per hour, and a fall of 3 inches per hour has been known.

The City of Washington (See Plate 1) extends from the eastern branch westerly about 5.7 miles, and from the Potomac river northerly about 3.2 miles at the point of greatest breadth, with an area of 9,548 square miles.

All elevations are from the city datum, which is mean high tide at the Navy Yard, and is 2.91 feet above mean low tide. The various surburban villages are all under the same government as the city.

The population of the District is 203,459, of which 187,928 are within the city limits, giving a density in the city of 19,682 per square mile. The population is not at all evenly distributed,

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but there are no statistics to show what the density is in the most thickly populated portion.

Tenement houses, in the common acceptation of the terms, are almost unknown in the city, and in general each family occupies a house. There are no records kept by which the number of houses can be determined.

The District of Columbia was definitely located as the seat of Government of the United States in the year 1791. At this time Georgetown, which was settled more than half a century earlier, had grown to a town of considerable size. The plan of the city, which was originally prepared by Major L'Enfant, has been strictly adhered to, and to his good judgment and forethought the City of Washington is indebted for its wide streets and avenues, and numerous public parks. Up to the year 1871 the government of the cities of Washington and Georgetown were strictly municipal, each having a separate corporate existence, but at this time a Territorial Government was established for the District of Columbia, repealing the charters of both cities. This form of government was in term abolished by an Act of Congress approved June 20, 1874, and the present form of government, by three Commissioners, as will be explained later, adopted. Though the Territorial Government was short-lived, and has been the subject of bitter controversy, it marked the beginning of a new era for the city, an era of public improvement. During the three years of its existence about 190 miles of streets were paved with wood, stone, or concrete; the old canal extending from near the Botanic Garden to the Potomac at the foot of Seventeenth street, was filled up; Tiber creek extending from boundary to same distance south of Pennsylvania avenue was arched; an extensive system of sewerage was planned, and many sewers constructed. Had more time been taken in which to make these improvements, the work would undoubtedly have been more thoroughly done. The wooden pavements, of which there were many miles, soon decayed and have all been replaced with either granite block or asphalt. Pipe sewers at that time were laid without any concrete around them, and as they soon become choked with the roots of trees, many of them have been relaid, and others must be in the near future.

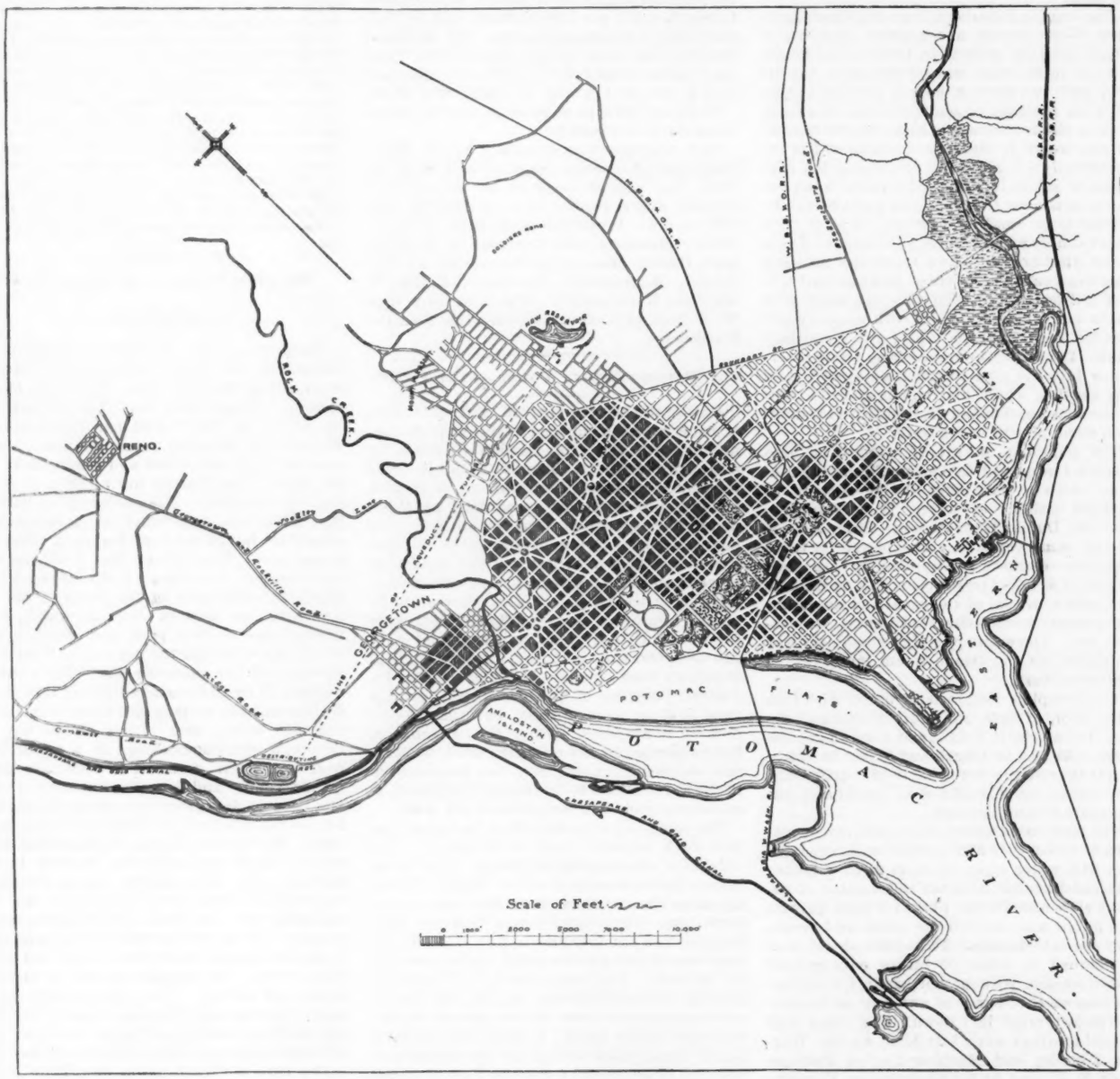


Plate I.—Map of Washington, D. C.

Management of Public Works.

The executive officers of the District of Columbia consist of three Commissioners, two of whom are appointed from civil life by the President of the United States, with the advice and consent of the Senate; the third being detailed from the Engineer Corps of the Army, and must be an officer above the lineal rank of captain. These Commissioners are appointed for a term of three years. The Commissioners possess all the powers usually held by a board of public works, and make all appointments in the engineering department of the district. The Engineer Commissioner is at the head of the Engineer Department, and is allowed two assistants, who are also detailed from the Engineer Corps of the Army. One of the assistants has charge of all surface work, the other of the water supply and sewerage.

The following are the officers under the Engineer Commissioners, from whom an annual report is required:

Surveyor.
Parking Commission.
Inspector of Buildings.
Superintendent of Streets.

Inspector of Cements and Asphalts.
Property Clerk.
Water Department.

These will be taken up in the order named, and their duties given a little later.

There are immediately under the orders of the assistants to the Engineer Commissioner, a computing engineer, three assistant engineers, a draughtsman, and a varying force of inspectors. Each assistant engineer is furnished a rodman and axeman.

The computing engineer has charge of all office work, including the assignment of the field work to the different assistant engineers. The assistants have charge of all field work, and in general receive their orders from the computing engineer. On each piece of work there is an inspector, whose duty it is to see that the work is done according to contract, and to carry out the orders of the engineer in charge of the work. They each make a weekly report, in writing, to the Engineer Commissioner, giving a detailed statement of the amount of work done and force employed by the contractor for each day.

All linear measurements are made with Chesterman steel tapes, but no standard of measure is kept, and tapes are not tested.

In laying out work, both for surface and sewerage, a grade sheet is prepared, the blank form of which is shown below, which is kept on file in the office of computing engineer.

to the proper clerk, who prepares a statement of the account for this contract on the accompanying form (D.)of voucher; this next goes to the property clerk for his statement of materials furnished the contractor, after which it is sent to the assistant engineer for his signature, and in turn to the computing engineer, and the assistant engineer commission for their signatures.

to keep up the records of the office. All surveys of new streets, alleys, or subdivisions of squares or lots, which are made a matter of record, must be made by the city surveyor. He also gives lines for building purposes whenever called upon to do so.

On work that is to be recorded, measurements are made with wooden rods 10 feet long, shod with iron, which have been compared

RECAPITULATION OF CONTRACT NO. _____

Street _____ between _____

Contractor, _____ 188 .

Surface Sheet.	Grading, Cubic Yards.	Rock Excavations, Cubic Yds.	Haul over 200 feet.	12-inch Flagging, Lin. ft.	16-inch Flagging, Lin. ft.	Blue Stone Curb, Lin. ft.	Granite Curb, Lin. ft.	Circular Curb, Lin. ft.	Sewer pipe, Lin. feet.	Receiving Basins	Footwalk, Sq. yards.	Carriageway, Sq. yards.		

Assistant. *Computing Engineer.*

There is kept in the office of the compiling engineer, a set of maps, on a scale of 100 feet to the inch, showing the location and size of all sewers, the location of all manholes, catch-basins, and drops, the elevation of curb corners, and the grades of sewers at all manholes. When a sewer is constructed the inspector

with the standard measure at the United States Coast Survey Office. Steel tapes, wherever used, are tested by these notes.

On new work, stone monuments with a cross cut in the top, are set at the intersection of building lines at each corner or square. In making surveys inside the city limits, points are marked by nails driven in the sidewalks

_____ E. O., 1888 –

GRADE SHEET.

No. of Contract ——

—— Street, —— between ——

Reference to Field Book. _____ 188 .

Station.	Bs. & In.	Fs.	R. Lev.	Grade.	Cut.	Fill.	Remarks.

Hor. Scale _____

_____ Ver. " _____

Assistant.

_____ 188

Computing Engineer.

Form D.

No. _____, Vol. _____ 188 , E. D.

IMPROVEMENTS AND REPAIRS.

Account No. —— Contract No. ——

Chargeable to Appropriation for _____

_____, 188 .

Washington, D. C. _____ 188 .

District of Columbia.

To _____ Dr.

I hereby certify that I have carefully examined, measured and inspected this work, and that the quantities here given are correct. The field notes are recorded in _____

The work appears to be _____

_____ 188 .

Assistant Engineer.

On the left-hand page is given a plat showing the work to be done. All completed work is shown in black, and contemplated work in blue. A sheet giving the cut or fill, together with any other instructions, is furnished the inspector. On sewer work the grade of the sole of the sewer is given, and on surface work the grade of curbs. The depth of gutter and

keeps a record of the distance from a manhole to each Y branch, or junction block, put in for house connections, and reports it to the office, where it is entered in a book kept for that purpose in the office of the clerk who issues permits for making connection with the sewers.

There is now in course of preparation a set

MEASUREMENT SHEET.

No. of Contract _____

_____ Street, _____ between _____

Reference to Field Book, _____

_____ ,188

Grading.		Flagging.		Curbing—Feet.			Sidewalk.		Carriageway.		Cobble.	
Cubic Yards.												
Ordinary Excavation.	Rock.	12" Lin. Feet.	16" Lin. Feet.	Bluestone.	Granite.	Circular.	Dimensions.	Square Feet.	Dimensions.	Square Feet.	Dimensions.	Square Feet.

Hor. Scale ——

Assistant.

Computing Engineer.

Materials Furnished Upon This Contract.

Chargeable against Contractor.	Not Chargeable against Contractor.

I hereby certify that the foregoing is a correct account of material furnished, and that the prices charged are the net value of the material at the point where delivered, or in accordance with contract.

_____, 188 .

Property Clerk.

I have carefully examined the account, and find the prices according to contract and the computations correct.

The amount due the contractor is to be ascertained by deducting from the net cost of the work the amount of previous payments, and the value of the property chargeable against the Contractor _____

_____, 188 .

Computing Engineer.

Approved:

By order of the Engineer Commissioner.

_____, 188 .

_____ *of Engineers, U. S. A.*

crown of street, together with the slope of sidewalk, is given in each particular case. When a final measurement is made, a measurement sheet is prepared on the "Measurement Sheet" blank shown below, on the left-hand side of which a plat is made showing in detail the dimensions of each piece of the different classes of work. There is also a "Recapitulation Sheet," as shown above, giving a summary of all the work done under the contract. This recapitulation sheet is then sent

of maps, on a scale of 200 feet to an inch, showing the grades of all streets and alleys. Each year a map is prepared showing by different colors the amount and kind of pavements on each street.

City Surveyor.

The city surveyor is appointed by the Commissioners and is not allowed to have a deputy or assistant. He is paid by fees and furnishes his own help except a draughtsman, who is paid a salary by the city and whose duty it is

and noting the distance of these nails from the building lines. A record of these nails is kept by the surveyor on a slip of paper cut and filed in an envelope marked with the number of the square. All records of subdivisons are platted in books of a uniform size of 12½ by 19½ inches. The usual scale of the plats is 30 feet to the inch, but this is varied to suit circumstances, so as to bring the plat within the size of the book. These plats show the length of all lines and give all angles, but do not give measurements for starting points. All plats must be certified by the surveyor, the party for whom the plat is made, and two competent witnesses, whose names must be appended thereto.

Parking Commission.

The parking commission was organized in 1871 and is composed of three persons, appointed by the commissioners whose duty it is to superintend the planting and care of all shade trees. Trees are planted about one foot from the curb line in the sidewalks, and from 20 to 25 feet apart. The following extract from the Report of the Parking Commission for the year ending June 30, 1885, will show the kinds of trees planted:

COMMON NAME.	BOTANICAL NAME.
Ash-leaved maple or box elder	Acer negunda.
Sugar maple	Acer saccharinum.
Sycamore maple	Acer pseudo-platanus.
Soft or white maple	Acer dasycarpum.
Norway maple	Acer platanoides.
Black sugar or southern maple	Acer nigrum.
Red maple	Acer rubrum.
American linden	Tilia americana.
European linden	Tilia europea.
Sycamore or buttonwood	Platanus occidentalis.
Sycamore or buttonwood, European plane tree	Platanus orientalis
American ash	Fraxinus americana.
American elm	Ulmus americana.
Winged elm or Wha-whoo	Ulmus alata.
Slippery elm	Ulmus fulva.
Corkey white elm	Ulmus racemosa.
Carolina poplar	Populus monilifera.
Lombardy	Populus fastigiata.
Grecian or Athenian poplar	Populus græca.
Turkistan poplar	Populus, species turkistan.
Catalpa	Catalpa bignonoides.
Japan catalpa	Catalpa keimpheru.
Laurel-leaved willow	Salix pentandra.
Sweet gum	Liquidambar styraciflua.
Horse chestnut	Æsculus hippocastanum.
Kentucky coffee	Gymnocladus canadenis
Honey locust	Cleditchia biacanthos.
Ginkgo or maiden's hair tree	Salisburia adiantifolia.
Yellow wood	Virgilia lutea.
Deciduous cypress	Taxodium distichium.
Weeping cypress	Taxodium sinensis.
Pin oak	Quercus palustris.
Willow oak	Quercus phellos.
Swamp white oak	Quercus bicolor.
White oak	Quercus alba.
Tulip tree	Liriodendron tulipiferum.

During the past year there have been planted 2,084 trees, making a total number on the streets of 64,571.

All public parks or reservations in the city, are the property of the United States, and in the care of the Superintendent of Public Buildings and Grounds, who is an officer detailed from the Engineer Corps of the United States army, over whom the District Commissioners have no control. There are 246 of these reservations, with an area of 408½ acres.

Inspector of Buildings.

The duties and powers of the Inspector of Buildings are fully set forth in the following:

Building Regulations of the District of Columbia.—These regulations originally framed under authority of an Act of Congress of June 14, 1878, have been amended by the District Commissioners under date of April 11, 1885.

The Inspector is appointed by the "Executive Authority of the District of Columbia," and he must be an architect, or an architect or builder, and have been engaged in such business for at least seven years previous to his appointment. His salary is $2,400 per annum, and he must give a bond in the sum of $10,000.

He is under the supervision of the Executive authority, charged with the survey and inspection of buildings, and the enforcement of the building regulations prepared by the District Commissioners and such other duties relating thereto as the commissioners may assign. He must sign and issue all permits, certificates and notices under these regulations; keep on file all applications and notices received; keep a record of all violations of regulations and report them, when necessary, to the authorities and keep blanks for permits, certificates, etc. He must examine all buildings in course of erection or repairs; examine reported dangerous or defective structures; have the supervision of the erection of *all* heating apparatus, and examine and approve of the plans of any building intended as a hotel or lodging house, place of public assembly, etc.

The Building Regulations under which the Inspector acts cover the usual restrictions as to material and methods, generally found in modern cities of the first class. Some sections of the Regulations approved by President Washington, October 17, 1791, are still in force.

The fees under these regulations are as follows: for each permit for a new building or other structure, two dollars for each building; for each permit for alteration or repair, one dollar for each building or structure; for each permit for vault, two dollars per lineal foot of proposed vault; for each permit for area in front of the building-line of any building now erected, or any structure or building hereafter erected, after the same have been completed, one dollar for each area; for all other permits and certificates, one dollar each; for measuring, in the matter of party walls, the fee shall not exceed five dollars, except in cases of express agreement; and for examination of dangerous buildings, defective escape facilities, or other defective or insufficient arrangements or appliances in public assembly-rooms, on appeal, the fee shall be thirty dollars.

(TO BE CONTINUED.)

Rainfall; the Amount Available for Water Supply.*

BY DESMOND FITZ GERALD, C. E.

I know at conventions of this kind it is desirable not to present too elaborate papers, and I shall therefore endeavor not to detain you long. I intended to have written out carefully what I have to say on the subject upon which I have been announced to speak, but have been unable to find the time to do it fully. This subject of rainfall is one of the most important, that can engage our attention, especially when we consider in connection with it the amount of water that is available for the uses of man. It has a particular interest for those of us who are engaged in the construction and management of works for the supplying of water to cities and towns.

It is only within a comparatively few years that the rainfall has received very much attention in this country, and it is surprising how much misinformation there is in the popular mind on the subject. You hardly take up a paper without reading something about the influence that the removal of the forests has on the amount of rain that falls from the clouds and even among scientific bodies there does not seem to be any very definite knowledge in regard to this matter. Not a great while ago I read a statement, made at a meeting of one of the Western societies, that since the construction of the Suez canal, the planting of a few trees along the banks of the canal had had the effect of increasing the rainfall. This was such a direct assertion that I took the pains to write to Mr. De Lesseps, the chief engineer, and received an answer from him, as I expected, to the effect that the time had been altogether too short for them to get any results from the planting of trees, and he would not venture to give any opinion on the subject whatever.

In England, where water is of more value than it is with us, and where they have had more time for the investigation of every phenomenon connected with rainfall, percolation, storage, evaporation, etc., there are more than a thousand observers of rainfall gauges, on an area somewhat larger than that of the New England States. If we look at a map of the United States, on which the mean annual rainfall is plotted, we shall find a considerable range in the hyetal areas. I have had sketched on a map in a rough kind of a way the mean annual rainfall over the whole country and the areas run from less than 10 inches in some sections, to 80 inches, in a small district on the Pacific Coast. You can see what a variety of results there are.

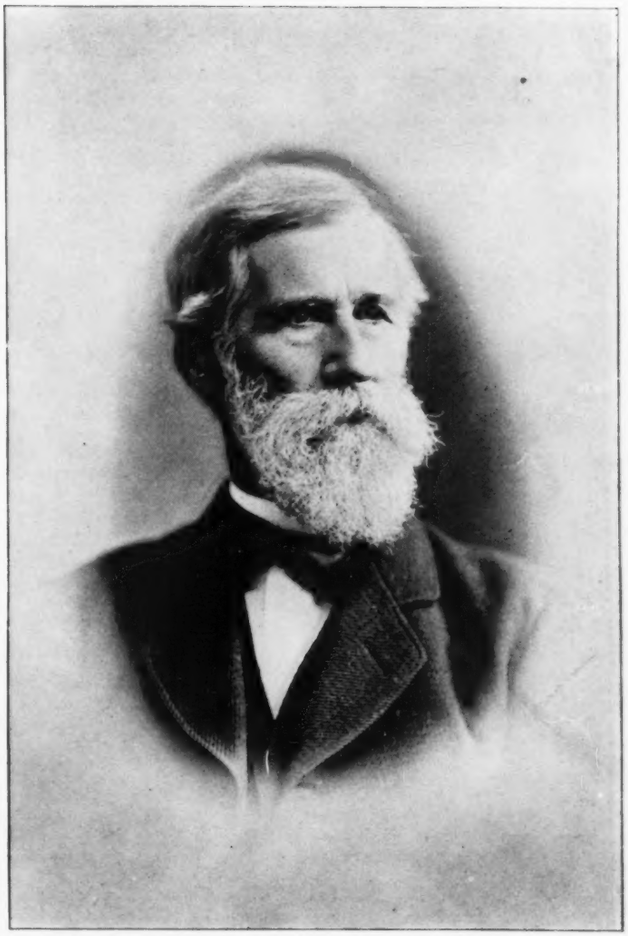
In the Gulf and in the Gulf stream we have an immense mass of very warm water. In a trip I recently made to the West Indies, I took the temperature three times a day. I started from New York with a temperature of forty-six degrees, which continued until I struck the Gulf stream off Hatteras, and then the thermometer jumped up immediately to eighty degrees, and remained at eighty degrees all the rest of the way to Nassau. You thus see what an enormous difference there is in the temperature of the ocean in a very short distance. From this mass of warm water, there must be an enormous evaporation. This is the great source from which we get our mean rainfall. There is a small district along the coast, which receives a slight increase from the Atlantic. when you get out beyond the Mississippi it is pretty dry, because the rainfall coming from the warm Pacific currents has been condensed against the tops of these mountain ranges and the clouds are almost entirely robbed of their moisture. We thus get a very low rainfall on the plains on the easterly sides of the mountains.

The mean of some thirty years of observation on the rainfall of Boston gives us yearly about forty-eight inches; and this forty-eight inches is so equally distributed through the several months that we may safely say that on an average we have four inches per month, though not exactly so, as we will presently see. If we examine a profile of the different years, we shall find a great variety in the amounts, running in a general way from thirty to sixty inches. The irregularity in the outline does not suggest any particular law of increase or decrease; in fact, our periods are rather short for this purpose. Within the last few years, however, we have had two very dry years, as most of you probably know who passed through 1880 and 1883; and it is to those two years that I particularly desire to call your attention, as there are several valuable lessons to be learned from their careful study.

In 1880 we had on the Sudbury river water shed 38.1 inches, and in 1883, 32.8 inches of rain. On the Cochituate water shed adjoining. we had 35.9 inches in 1880, and 31.2 inches in 1883. These figures agree sufficiently well, but in discussing the available amounts received, I prefer to take the larger water shed, namely, the Sudbury river, which has an area above our lowest dam of about 74 square miles. The Cochituate water shed adjoining covers about 18 square miles.

There have been a great many figures made from the results of the Cochituate rainfall, because we have such a long series, running from 1852, and on the Sudbury for ten years only. I think the results on the Cochituate are hardly as reliable after you go back a few

*From advance sheets of report of Fifth Annual Convention of the New England Water Works Association



Yours very truly
E. S. Chesbrough

years, on account of the imperfection of the methods of taking the rain obser ations.

And perhaps this is a good place to speak about the necessity of having a good gauge and seeing that it is properly exposed. All sorts of erroneous conclusions are drawn from imperfect data, and it is very desirable for us all to endeavor to get our data as correctly as possible. Some time ago, for the New England Meteorological Society, I devoted some study to the question of gauges, and I found our standard gauge used on the Sudbury and Cochituate, which is 14.85 inches in diameter, a very convenient size when the water is weighed, but there are a great many reasons why it is rather a large gauge for ordinary observers; and I have found as a result of a couple of years observations that a gauge 8 inches in diameter gives just as good results. Differences in amounts of rain collected by different gauges depend more upon other things than upon the diameter. We have adopted this gauge (sample shown). It is made of copper, the ring is carefully turned, and I think it is a very good gauge. This piece is put in to prevent evaporation. The rain is poured into this measuring tube, and is multiplied ten to one. That is, if we have 1 inch in the gauge we have 10 inches in the tube. The cost is quite reasonable, only five or six dollars. There have been some alterations made in the gauge in the last year; and instead of having this wide scale we have this square one, which gives very good results. I hope if any of you are anxious to start a set of rainfall records, you will look a little into the subject of getting a proper gauge. This makes a very good snow gauge, because it is so deep. I found that one of my predecessors had been using a gauge, on the outside ring of which he had soldered a piece of tin, about half an inch beyond the ring, and carried it up about a foot above, and he thought he was getting a very nice snow gauge out of it; but of course he was increasing the area by quite a perceptible percentage. I have not been able to find out exactly how many years that kind of a gauge was used.

On the Sudbury we have good records indeed; the measurements have been carefully taken, and I think the figures as to the rainfall are quite reliable.

Having called your attention to the mean annual fall, 48 inches, and its fluctuations, let us now look for a momont at its distribution through the different seasons of the year. In the spring we have on the average 12.42 inches; in the summer, 12.83 inches; in the autumn, 22.33, and in the winter, 10.44. You will thus see that the spring, summer and autumn are very uniform in amount, but that the winter is somewhat below the other seasons, As you get back from the coast this seems to change somewhat, and a little further back from the coast all through the New England States, the autumn I think, as a general rule, gives somewhat more, and the winter almost always gives a little less than the other seasons. When you get over to the Pacific coast the whole order is reversed; in fact somewhat so in the Mississippi valley, but for New England it is safe to say that we have about the same rainfall during the spring, the summer and the autumn, and in the winter slightly less.

It surprises most people who have not studied the question to find how equally distributed the rainfall is. Taking the several months we find the mean is as follows;

January, 3.60; Febuary, 3.41; March, 4.22; April, 4.16; May, 4.04; June, 3.47; July, 4.37; August, 4.99; September, 5.37; October, 4.22; November, 4.55; December, 3.42.

I have referred to the rainfall of 31 inches in 1883 as being the smallest rainfall we have had since we began making observations on the water sheds which supply the city of Boston. But there are records of smaller rainfalls. In 1846 Boston had 29.9; Waltham, 26.9; Lowell, 28; Cambridge, 30.4; Providence, 30.5; and in 1825 Lowell had 28.5, and in 1822 I find a record of 27.2 for Boston. After checking some of these records with other towns in the vicinity, I have come to the conclusion that we may adopt 28 inches for the minimum rainfall in the vicinity of Boston.

The available amount of the rainfall is the actual amount caught on a given shed, as measured in the channel or stream forming the main drain of the area. The rest, or the difference between the amount running off and the amount falling is lost in different ways, but almost wholly by that great equalizer evaporation. In this connection it may be a surprise to some persons to learn that the evaporation from the surface of the ground in the course of a year is a very large proportion of the evaporation from an exposed surface of deep water. I have recently been looking into the matter of evaporation, and perhaps it may interest you to know that the approximate evaporation during a year from a water surface is somethir g like 35 inches. You see what an enormous loss there is by evaporation, and you see where all the water goes in the summer. In fact, after a heavy rainfall, if you examine into the matter, you will find, that a proportion of the rainfall comes up again even after it has gone down five or six feet below the surface of the ground It comes up again to be evaporated. So you see that it is very easily explained why we collect during the summer such a small percentage of the rainfall in the streams.

The mean yearly percentage collected on the Boston Water Works has varied from 25 to 60 per cent., depending on the distribution of the rain during the several months. The mean is about 42 percent. This available amount of water collectable on any drainage area is the initial starting point for the designing of works for water supply, and it will be evident after a little reflection that it is not the mean amount collectable, but the minimum amount to which we must give especial attention, for it is the dry years, and the minimum collectable percentage, which forms the weakest links in the chain, and therefore the true measure of our supply.

I suppose most of you are familiar with the trouble we have been through on the Cochituate works. The great difficulty with us all is to get the people in our different towns and cities to realize the importance of looking ahead. It is almost impossible to make people believe in the necessity of providing for the future. When the Cochituate Aqueduct was built a great many people thought the city of Boston would never be large enough to use the works to their full capacity, yet inside of ten years the Mayor had to issue a proclamation asking the people to economize in their use of the water. For the ten years preceding 1872 it was a running fight to get an appropriation for an additional supply.

As illustrating the fact that the minimum and not the mean must be the guage of our work, if you look over some of the Parliamentary reports of Great Britain you will find that they have had a great deal of trouble in England because of the fact that the average flow of the streams and not the minimum was taken as their standard. A few years ago some of the larger towns there had to cut down their supply to twelve hours a day, and others had to cut down the consumption to seven gallons per capita. The brewers and manufacturing establishments were shut off altogether.

In 1880 we collected 12.5 inches, or 33 per cent. of the rainfall on the Sudbury, and in 1883 we collected 11 inches, or 33½ per cent. of the rainfall. On the Cochituate basin, however, we collected only 10 inches of rainfall during both of these years, owing to the larger loss by evaporation, and other peculiarities of the water shed. These are smaller than have ever been taken as limiting supply, and as they come from actual practice and careful measurements, the lesson is a most instructive one. The figures seem small, but if we examine the distribution of the rain carefully, I think we shall be warranted in coming to the conclusion that with a slightly different distribution during the summer months we should have had in 1883 as small a collection as 8 inches.

But first let us see what available percentage of the rainfall is collected in the different months of the year, and we shall then get an idea of the effects of the monthly distribution There are four months of the year when we may at least have little anxiety as to the available supply, viz., February, March, April and May. The mean for none of these months during the past ten years on the Sudbury river has fallen below 60 per cent. of the rainfall, and the mean for two is above 100 per cent., sometimes going above 200 per cent. Of course as the snow collects during some winters and then runs off during the warm spring rains, we very often get much over 100 per cent., sometimes over 200 per cent. of the rainfall in the streams in the month of March. Then there are four months, July, August, September and October, when the amount of the rainfall seems of little importance as affecting the yearly available amount for water supply, as the available percentage collected during these months is for a mean only 10 per cent., and has sometimes fallen as low as 5½ per cent. of the rainfall (1880).

You must remember I am speaking now of the available amount collectable, and not the uniformity of flow during the year, which is a very important matter. If we could have very large rainfalls in the summer and very small ones during the winter, we should have a more constant flow of the streams. This would be very advantageous for water works, but at the same time we would not have as large an amount collected during the whole year,—that is the total available amount would be very much less.

As examples showing how little the amounts of rainfall during the summer and early autumn months affect the question of the available amounts collectable in the course of a year from a given water shed, I have selected the following cases:

Month.	Rainfall.	Collected.
July, 1876	9.1 in.	3.5%
Aug., 1878	6.9	12
July, 1879	6.5	7
July, 1880	6.3	5
Sept., 1882	8.7	6

For the general study of this subject, I should like to make a little different division in the months of the year from that made in the calender and it will be something like the following:

1st. Period, from the middle of April to the middle of June, when there is great percolation and moderate evaporation.

2nd. Period, from the middle of June to the middle of October when the rainfall is of little importance and but a small percentage of it is collected.

3d. Period, from the middle of October to the middle of December, a period of the greatest importance, especially where water is stored because then the water tables are filled and basins and reservoirs can be replenished

somewhat from the flow of the streams if the rains are copious, as the percentages collectable amount to about one third of the rainfall.

4th. Period from the middle of December to the middle of February there is a good deal of snow generally. The water table does not get much of the water, on account of the frost but the collectable percentage amounts to about half the rainfall.

5th. Period from the middle of February to the middle of April when the percentage collected is so large that but little attention need be paid to the study of these months. The frozen ground being perfectly impervious to water, practically all that falls from the clouds during this period runs off into the streams or is evaporated, and the latter amount is of course small. The month of February is generally the first month that can be depended upon to fill completely those storage reservoirs, lakes, or points which have been exhausted by heavy droughts during the second, third and fourth periods.

If the rainfall is small during the months of percolation the amount of rainfall collected during the succeeding months is correspondingly small. In 1880, the rainfall for May was but 1.1 inches, and that for June 2.1 inches. Although 15.6 inches fell during the next four months' only 5½ per cent. of this reached the streams. In 1883 the same amount of water was collected from 10.5 inches of rain. I have noticed, that if the rainfall is very large during the summer for one month, the per cent. of the rainfall collected during the next month will be considerable, but this does not seem to extend over more than one month, or at any rate not over a month and a half. From the middle of December to the middle of February a large proportion of the rainfall comes in the form of snow, the ground is frozen, and is as water tight as if a rubber blanket covered the surface, excepting, perhaps in case of heavy woods; and this is where the forests come into play, for there the water will percolate to a considerable extent during the winter, while on the open ground it all runs off, or certainly does not reach the wate tables. If the rainfall is heavy during these months, a very large percentage finds its way into the streams. If the rainfall is in the form of snow, of course it swells the percentage during the spring.

As a general rule the larger the rainfall the greater is the per cent collected. On the Sudbury river the maxium rainfall 57.9 inches in 1878 gave us 52.5 per cent. The minimum in 1883 32.8 inches of rainfall gave us 33.6 percent.

In 1866 the rainfall on the Cochituate was 62.3 inches of which nearly half fell during the four months of summer, viz.:

July 13.35 inches; Aug. 3.98 inches; Sept. 8.36 inches; Oct. 3.43 inches.

Of these amounts 14 per rcent only was saved. The total available percentage for the year was 25.7 per cent, which was the smallest recorded on the sheds we are considering.

The following figures show the distribution of the rain during the summer months of 1883 when but 33 per cent of the annual rainfall was collected at Lake Cochituate.

July, 2.4 inches; Aug. 2.7 inches; Sep. 0.7 nches; Oct. 1.5 inches; total 7.3.

This was a very favorable distribution of the rain as far as the total available flow of the water shed is concerned. Had there been double this amount, or 14 inches in the four months under consideration, the 33 per cent. would have probably fallen to at least 25 per cent. for the year, which would have given us 8 inches instead of 10.

It is evident that we must come to a very dry year as being the weakest point in our chain, and that is about 28 inches. In 1868 we collected as little as 25 per cent. of the total amount of the rainfall. If we should have with the 28 inches as unfavorable a distribution of the rain as we had in that year, in other words, a very large rainfall during the summer, and a very small one during the remainder of the year, we would probably collect only about one-quarter of this, which would bring us down to 7 inches instead of from 12 to 15 inches, which has generally been taken. This would reduce the water in the Sudbury river, for instance, from about 40,000,000 gallons per day, for the minimum yield, to about 28,000,000, or something of that kind. Of course, this is, like everything else in nature, periodic. It is liable to come at any time; it may not come for a great many years. But it seems to me that it is a part of wisdom either to provide for it in the storage, or to decide to cut off some portion of the consumption during such an unusual year.

Numbering Houses in Paris.

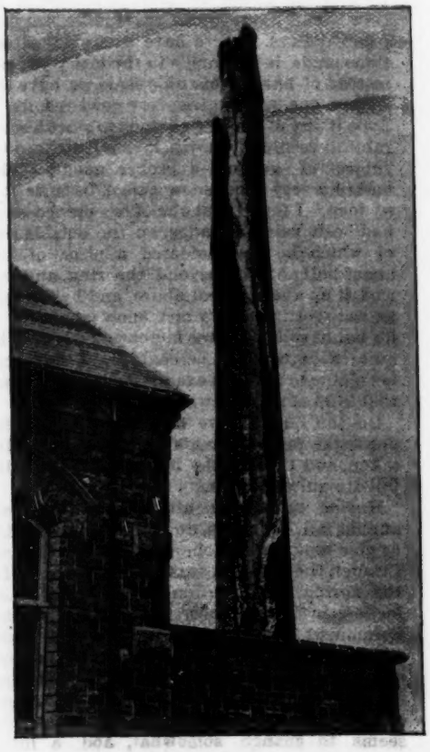
Up to the period named by Cunningham, 1764, probably very few streets in Paris had been numbered throughout, although it is quite clear that many places had been partially numbered 50 years earlier. Blavignac, in his "Histoire des Enseignes," Geneva, 1876, page 70, says that the first attempt at numbering houses took place in Paris in 1512 on the houses (68 in number, "His. Signboards," page 30) that were built upon the Petit Pont or Pont de Notre Dame. For years, nay, even for centuries, there was no echo of repetition. Mr. Blavignac goes on to say that Geneva was perhaps the first city to seriously adopt the improvement in 1782. The whole town was divided into four quarters, and each quarter was separately numbered. Strassbourg followed in 1785 and Rouen in 1788. An order for the same thing in Paris dates 1768, or four years later than ours in England, from which it appears to have been copied. It met with systematic opposition. M. Blavignac quotes Mercier's "Tableau de Paris." 1782, as saying that they began to number the houses in the streets, but suspended that useful operation he does not know why. It seems that the more important houses with *portes cocherers* objected to being inscribed with a number. Could a noble *porte cochere* be degraded to follow on after and as it were beneath a number on the shop as a common *roturier*? The catchpenny triple jingle of republican *egalitè* had not yet been posted up at every street corner. The true numbering, however, did not take place till February, 1805, when the decree became obligatory, and the municipal bodies defrayed the expenses.—*Notes and Queries.*

Fall River Water Works Chimney.

On the 24th of August 1885, at 5.42 P. M., the chimney at the Pumping Station of the Fall River Water Works, 112 feet in height, was struck by lightning. The lightning struck at the top of the chimney, and a portion four feet in breadth was stripped out of the shell, from the top to within 18 feet of the ground. The core was also cracked for a length of 35 or 40 feet. Though left in very dangerous shape and apparently ready to fall any moment, the chimney so survived the shock that the draught was not hindered, and thus the water supply of the city, though threatened, was was not immediately interfered with.

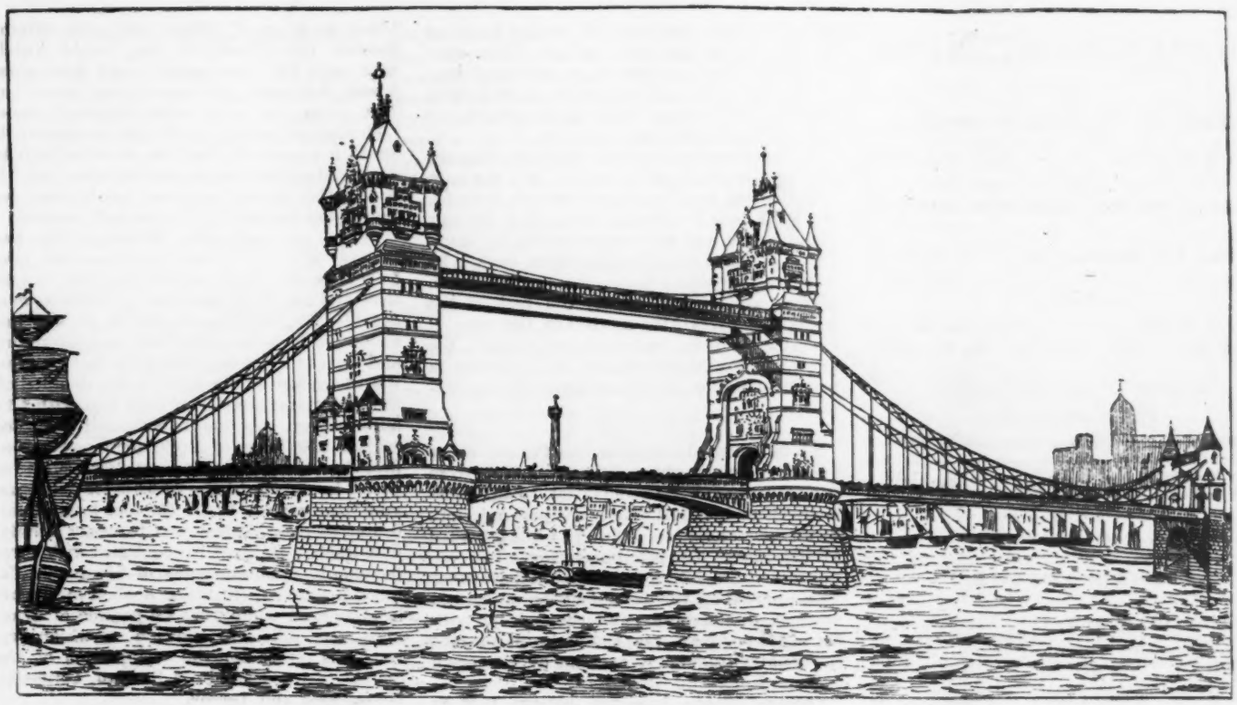
The next morning the Board met at the Pumping Station, and decided to take steps at once for the erection of a new chimney. It was decided to have the new chimney of the same height as the old one, with a core of 4 feet in diameter (1 foot more than the old) and, for greater safety, to have the location 120 feet north of that of the former chimney. It was thought advisable to increase the size of the core in view of future necessity alone, for no trouble was ever had with the first; the additional expense of making this change being small. The core was connected with an underground flue. The chimney was completed October 15, and a temporary connection was made with it by 24-inch cast iron pipe through the north window of the boiler room.

The next matter which commanded attention was the taking down of the old chimney. About 30,000 feet of lumber was purchased, and used for protecting both boiler houses and the steam pipe from any fragments which might fall. Several plans for leveling the chimney where proposed and duly considered. An unsuccessful attempt was made to pull the chimney down by a rope, with the use of a Hook and ladder truck, after which it was decided to abandon methods of this sort as being too dangerous. The safest way seemed to be to shatter the chimney with shot; and this plan was adopted. Fourteen shots were fired, all telling on the chimny with the exception of one which exploded before it reached its mark. Between 40 and 50 feet were leveled, and the most dangerous portion of the chimney removed. A staging was next erected on the top of the boiler house, and the remainder of the chimney taken down without difficulty.



The total expense attending the building of the new chimney, removing the old, and repairing damages, was nearly $6,000. The new chimney was provided with a copper lightning rod, ¾ inch in width and ¼ inch thick, 12 ounces to the foot, with earth plate 3 feet square, 16 ounce copper. The engine house, boiler house, and the dwelling house were also supplied with the same kind of rod.

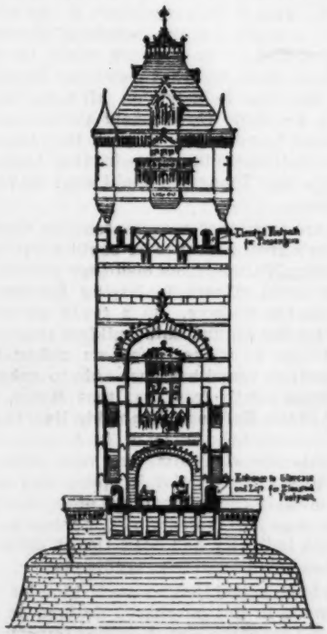
Our illustration is from a photograph of the damaged chimney taken soon after the accident.



The Tower Bridge, Shut.

The Tower Bridge, London.

The new Tow r Bridge, is to cross the Thames immediately below the Tower of London. The want of a bridge at this spot has long been recognized, owing to the congestion caused by the enormous never-ceasing traffic over London Bridge, and also for the accommodation of the east end of London, and for the improving of the communication



The Tower Bridge, Stairway.

between the north and south sides of the river below London Bridge. Mr. Horace Jones, the City architect, had, by direction of the Corporation, prepared at various times since 1876 a number of schemes and reports upon this subject; and a Committee of the House of Commons reported strongly on the propriety of improving the means of communication between the north and south sides of the river below London Bridge, and suggested that the Corporation should take upon itself the task of erecting a bridge with mechanical openings below the Tower. The Corporation referred the question to the Bridge House Committee, who directed Mr. Horace Jones to prepare designs for this purpose. After mature deliberation the committee selected one on what is known as the "Bascule" principle, and the Court of Common Council, adopting such selection in October, 1884, referred it back to the Bridge House Committee, by whom the necessary steps were taken for obtaining an act of Parliament.

This design is in effect the design approved by Parliament, and which received the Royal Assent on the 14th of August, 1885. The illustrations show the bridge open and closed. As will be seen, the bridge portion is carried by two massive picturesque Gothic towers, in which provision is made for the necessary machinery for opening and closing the center span to allow the largest shipping to pass through. Lifts on either side as well as an internal staircase are provided for the use of foot passengers when this is open. The lifts communicate immediately with the upper footway, so that the foot traffic is never interrupted. The center leaves of the bridge when open will be flush with the piers, thus leaving a clear opening or freeway for the shipping to pass of 200 feet. When the bridge is closed there will still be sufficient height at high water for the ordinary traffic of the river to pass under. The approach roads and footway will be 60 feet in width. The land spans of bridge will be 60 feet and the center span nearly 50 feet wide. The two land spans will be suspended as shown.

The materials proposed to be used are, for the lower portion of piers up to the parapet line of bridge, grey granite, the upper portion of towers in a hard red brick, with Portland or other hard-stone dressings. The opening passage of a vessel and closing of the bridge could be accomplished in four or five minutes, but if even double that time once or twice in the course of a day is absorbed, it would be no material interference with the road traffic. The Act of Parliament having been obtained, the Court of Common Council again referred it to the Bridge House Estates Committee to

The Tower Bridge, open.

carry out, and with the approval of the court Mr. Horace Jones was appointed architect and Mr. John Wolfe Barry engineer, under whose joint superintendence the work is being carried out. The foundation stone was laid June 21th by the Prince of Wales.—*Pall Mall Budget*,

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RAILROAD MATERIAL FOR SPAIN.—Two locomotives, several cars and a large amount of railroad material have recently been shipped from New York to Almeria, Spain, for the Marvel Iron Ore Company. The steel rails are to be furnished by English manufacturers.

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TABLE OF CONTENTS.

	PAGE
Montgomery, Ala., Water Works	113
The Possible Motive Power of the Future	113
Kentucky's Turnpike System	113
Municipal Engineering (*Illustrated*)	113
Rainfall; the Amount Available for Water Supply	116
Numbering Houses in Paris	118
Fall River Water Works Chimney (*Illustrated*)	118
The Tower Bridge, London (*Illustrated*)	119
Editorial Notes	120
Our New Navy	120
Railway Extension in the English Colonies	121
Steel Sleepers for Collieries	122
Gold in the Transvaal	122
Municipal and Sanitary Engineering in the City of London	122
Obituary—E. S. Chesbrough, C. E. (*with Portrait*)	123
Personal	124
Correspondence	124
Engineer's Surveying Instruments—Their Construction and Use (*Illustrated*)	124
Water	125
News of the Week	125
Market Report	126
Market Summary	126
Building Items	126
Soda Locomotives	126
Railroads of the World	126

IT is with deep regret that we announce the death of Mr. E. S. Chesbrough, Past President of the American Society of Civil Engineers, the originator of the Chicago system of water supply and sewers, and lately Consulting Engineer to the New Croton Aqueduct.

Since his return from Spain his health has been steadily failing, and Wednesday night his noble life was closed, peacefully and painlessly.

It has been given to but few men to carry through their business and social relations, such universal love and esteem, as was awarded Mr. Chesbrough, and none have carried a higher type of christianity, or made it more thoroughly a part of themselves.

The profession of engineering in America loses one of its oldest members and brightest lights, and both individuals and municipalities will miss his wise counsel and the benefit of his ripe experience.

THE paper of Mr. Jeans, elsewhere given, and the temper of the discussion following is of very great interest to Americans, if it be only to show us that England and her Colonists are awakening to the fact that millions of money are being paid to the United States annually for grain, etc., that could just as well be expended among her own people, were all other conditions equal.

The British Colonies seem gradually to be drifting away from their Mother England and show decidedly less conservatism and more progressive spirit than the people of the United Kingdom; in many respects they more resemble Americans in their enterprise. They are young yet, but are growing lustily, and with a soil and climate in some respects more favorable than our own, it is well to keep an eye upon them and their doings. They may loom up in the near future in awkward competition with the food exporters of the United States and a foreign trade of $150,000,000 per annum, is no mean thing to loose.

We can console ourselves with the thought that we too are growing rapidly, and can soon consume our own crops great though they be. We must look to manufactures then for our export trade, and with raw material in abundance, well fed and plentiful labor backed by American inventive talent, there is no reason why we should not supply the rest of the world with everything needful in the way of machinery, tools, railways and ships. We know how to make them, the only requisite is to cultivate the market, and force it if necessary.

SOUTH AUSTRALIA handles the Chinese labor question in a somewhat different manner from our brethern of the Pacific Coast. The Legislative Council of that colony has just rejected, by an over whelming majority, a bill intended to discourage Chinese imigration. The opponents of the bill argued that Asiatic labor was essential for the developement of certain sections of that colony, and the present poll-tax of $50 per man was sufficient to prevent the country from being overrun by the scum of Hong Kong and SINGAPORE.

The Australians, however, believe that as the ordinary Chinaman does not contribute to the general revenue anything like the amount obtained from the average European, it is legitimate and perfectly proper to increase his value as a tax-payer by exceptional means such as a poll-tax. Exceptional sanitary and other regulations are also advocated, including a provision protecting the interests of Europeans in the matter of gold discoveries. In Queensland under the system in vogue now Chinese are excluded from gold-fields discovered by Europeans for a period of two or three years. It is only proper to say however that, judging from the Colonial press, the Chinaman is tolerated there as a necessary evil only.

Our New Navy.

IT seems as if we were at length passing the state in which for so long a time we have maintained our navy, for the sole benefit of our navy yards, and were started towards the construction of a navy that will not be a scoff to the rest of the world as well as ourselves.

The origin of this improvement dates from June, 1881, when Hon. Wm. H. Hunt, Secretary of the Navy, appointed an Advisory Board which reported the necessity for seventy cruisers. It was quickly seen by our cousins over the water, that building such a number of cruisers would lead to a development of our open hearth steel works and ship yards that would make us very troublesome competitors in ship building, as well as in other industries, and every effort has been made to delay as long as possible the commencement of work and reduce the number to be built, they even, procuring one paper of this city to state editorially that we could not build ships, and advising our recourse to the ship yards of England, thus developing the resources of a possible antagonist, a proposition which was rapturously seconded by our contemporaries of England, *Engineering* and *The Engineer*, but by no other paper that we have seen. Under these influences it was not until March 3, 1883, that the bill was passed authorizing the construction of the Chicago 4,500 tons displacement, the Atlantic and Boston of 3,000 tons each and the Dolphin of 1,500.

Why the latter vessel was designed for a fifteen-knot speed when that year Cramp finished the Atlanta for Jay Gould, which, with only 568 tons register and 2,000 horse power, has made the fastest four hours run ever made by any screw-steamer under 7,000 tons, averaging in the last regatta 16.707 knots, is a question that can probably only be answered by the Board that designed her. It is doubtful if any one man would have assumed the responsibility of so low a speed.

By the act approved March 3, 1885, two cruisers of not less than 3,000 or more than 5,000 tons, one heavy armed gun boat of 1,600 tons, and one light gun boat of 800 tons were provided for, the plans for which are now just about ready to be submitted to contractors, and one of the closing acts of the last congress was to appropriate money for two double-bottomed armored vessels of 6,000 tons with 8,500 horse power, one double-bottomed protected cruiser 4,000 tons, of 10,000 horse power, one first class torpedo boat to cost $100,000, and as noted in our last issue $350,000 for one dynamite gun cruiser to be 230 feet long, 26 feet beam, to draw 7½ feet, and to steam twenty-four knots. It is to be equipped with three pneumatic dynamite guns, of Lieutenant Zalinski's pattern, throwing a shell 10½ inches in diameter, containing 200 pounds of dynamite, one mile. In addition to which provision is made for the completion of the double turreted monitors Puritan, Amphrite, Monadnock and Terror.

All of this will require some 30,000 tons of American steel and iron in plates, armor and machinery, besides a great many days work by the better class of mechanics, and as the armor it to be rolled in this country, we will not hereafter have to depend on foreign sources for that very essential munition of modern naval warfare.

It would have pleased us if it had been specified that at least one of these new vessels should be built on both the Pacific and Gulf coasts. This is an expenditure of the money of the country for the benefit of the whole country, and no expenditure could be more judicious than one that developed centers of ship building industry on all three of our coasts, and some Government assistance will probably be necessary to start that business on the Gulf where the cheap irons of Alabama, Georgia and Tennessee would soon make it a success.

We are sorry that notwithstanding Captain Walker's great influence he could not prevent Secretary Whitney from insulting the ability of our naval officers by buying foreign designs for the cruisers. As a trade advertisement for the English ship builders there may be millions in it, but when we reflect that since 1851 no vessel has been able to take the "America cup" from us, that Hurst, the Agent of the National Steamship line, is said to have carried the model of the America over from this side with him, and that many of our coasters are superior in speed and more economical in repairs than any other steamers of the same size in the world, it seems as if a needless indignity had been thrust upon our naval and civilian marine architects.

It is to be hoped that no such blunder has been made in the purchased designs as was made in that of the British cruiser Imperieuse, which draws about as much when launched as she ought to draw when fully armed and with her stores on board.

It is also to be regretted that more torpedo boats were not ordered. England had last summer completed and building 129, France 76, Russia 125, Italy 53, Holland 24, Norway and Sweden 15, Austria 14, Denmark 9, and Germany has decided to bring her torpedo fleet up to 150—all to be built in her own yards, and we do not hear that Bismark buys designs.

Railway Extension in the English Colonies.

From a paper lately read by Mr. J. S. Jeans, before the Conference at the Colonial and Indian Exhibition in London on railway extension in the colonies, we make the following extracts:

The author first noted the importance of railroads in opening up the immense virgin lands of these dependencies, and said that in the fifteen principal colonies, including India, Canada, and the Australias, there were now 30,000 miles of railroads, or one mile to every 263 square miles of area, and to every 7,300 inhabitants. Contrasted with other countries, in the United States, there was one mile of railroad to each twenty-five square miles of territory and every 2,300 inhabitants, and in the United Kingdom one mile to each six square miles of area and every 2,000 inhabitants.

Mr. Jeans next explained the possibilities of the Australian lands and India, as growers of cereals, etc., and remarked that if these countries had solved the railway problem as effectually as had the United States and "if the rates of freight were as cheap, and as well adapted to the development of the trade, there would be no need for the dependence upon the American colonies that now exist." Between 1868 and 1882, the imports of wheat alone in England from its colonies had increased, for the Dominion of Canada, from less than 1,000,000 to over 3,000,000 cwts., and from 500,000 to 5,000,000 cwts. from India. Mr. Jeans thinks that these figures prove the capabilities of these colonies as wheat producers.

The author next referred to the experience of the United States in the use of railroads in developing their foreign trade. He showed that in 1875 there were 20,000 miles of railroads built in America as compared with a total foreign trade, including exports and imports, of $536,000,000; in 1870, 49,000 miles of road and $913,000,000 of foreign traffic, and in 1883 with 120,000 miles of railroad the foreign trade amounted to $1,600,000,000. These figures show a great correspondence between the railway mileage and the development of foreign traffic in America, sufficiently so to show their value in extending this trade. This enormous development in the United State with low rates of freight, reduced on an average fully one-half between 1870 and 1884, has enabled them to compete with other countries "where otherwise that would have been impossible." This reduction in freight charges between the years mentioned, means a saving of $500,000,000 to the agriculturists and traders annually. Mr. Jeans believed that the reduction in rates had been the chief factor in so largely increasing American trade.

The author next considered the various methods adopted for financing the colonial railways, showing that in all cases their development has been limited from the outset by the exigencies of capital. One remarkable feature of the colonial railways was the readiness of the colonists to tax themselves for transportation facilities. Canada had contributed 178 millions of dollars out of 557 millions, expended on railways up to the present time; Australia has also largely contributed to her own railway extensions. In commenting on the cost of construction, Mr. Jeans thought that first cost should be economized in new and sparsely settled countries by one or other of the several expedients so well known to railway promoters and engineers. Though he did not consider a break of gauge a thing to be recommended, he yet thought that in some countries a narrow-gauge system would best fulfill the required conditions. In 1884, in India, there were 7,300 miles of railway of broad, and 3,600, miles of narrow-gauge; the cost of the former averaged £16,700 ($83,500) per mile, while the latter only cost £6,800 ($34,000). In Canada, back of Toronto, some hundred of miles of narrow-gauge were constructed at a cost of about £4,000 as contrasted with £8,000 for broad-gauge in the same provinces. In this case the narrow-gauge with a net income of £113 per mile yielded 4 per cent. on the cost of construction, while the broad-gauge with an average net income of £250 per mile yielded only 3 per cent.

Mr. Jeans stated that engineers estimated that the cost of a railway should not exceed ten times the amount of its gross annual revenue, and measured by this very rough-and-ready test, the colonial railways were found wanting. This was especially the case in Canada, where 125 millions had been expended against sixty-seven millions which they ought to have cost on the principle stated. In India, however, this theoretical limit of expediture was 163 millions, or twenty millions more than the actual outlay. Taking the eight principal English colonies together, the sum actually expended in railway construction to the end of 1884 was £347,000,000 sterling, or £46,000,000 more than the theoretical limit. But in the United Kingdom itself the railways built up to the end of 1883 had exceeded the limit as determined by actual revenue to the amount of £103,000,000.

The net earnings of colonial railways varied from £163 per mile in Canada to £804 per mile as a maximum in India. Queensland paid 4 per cent. average dividends on net income of only £268 per mile; but in New South Wales it required an average net income of £485 per mile to pay 4.2 per cent. On English railways at home it required a net return of £1,800 per mile to pay dividends approximating to those in Queensland. The author in this way sufficiently showed that colonial railway property was a very different thing from English, and that the two must not be tested by the same standard.

The average cost of railways built in the nine principal colonies, including Canada and India, was to the end of 1883, £11,900 ($59,500) per mile "as compared with £42,000 ($210,000) expended on British railways and £12,000 ($60,000) on railways in the United States.

The author calculated that a railway should open up the country through which it passes to the extent of about twenty miles on either side. Beyond that distance the cost of wagon transport became so high as to shut out agriculturists from competition with those who were within the twenty miles limit. If it were assumed, therefore, that the beneficial operation of railway facilities were not to be found beyond this area, it would appear that while the railways built in the United States were equal to the opening up of about 5½ millions of square miles, or nearly twice the whole area of the country, excluding Alaska, the railways hitherto built in Canada would only be equal to opening up about 400,000 square miles, or little more than one-ninth part of the whole area, while the railways already constructed in India only provided for the opening up of about half a million square miles, or rather more than one third of the total area. With regard to our Australian colonies, the 7,000 miles of railway constructed up to the present time were only calculated to provide facilities for 280,000 sq. miles, or one-eleventh of the whole era of the country. Reference was next made to the effect of railway facilities in increasing the value of the land. It was a well-known fact that in the United States, whereever railways had been built, the land had greatly increased in value. In many cases, where the land had only been worth from $1 to $5 per acre before the advent of railways, they rose to more than double that value when railways has been provided. If it were to be assumed that the effect of opening up the whole of the colonies in this way would be to add only 1s. per acre to the value of the land, the colonial landowners would be benefited to the extent of £256,000,000. But these were necessarily speculative figures, and, as a matter of fact, in nearly every instance the actual increase of value had been much greater than that assumed.

The author, in conclusion, urged that it was the interest of a colony, both immediately and remotely, to make every possible effort to promote the extension of its railway facilities. For this purpose it might safely venture to incur a debt that would not be justified for any other purpose. Not only so, but that justification would extend to the payment, if needs were, of a higher than the normal rate of interest on loans borrowed exclusively for productive works. It did not seem to be quite beyond the bounds of possibility that our colonies would yet come up to the standard of the United States in having one mile of railway to twenty-five square miles of territory. If that standard should ultimately be attained, our colonial railway mileage would not be the paltry 30,000 miles at which it now stands, but 330,000 miles, or about eleven times as much. Population and capital appear to be the only desiderata necessary to this result, and these would be ultimately forthcoming. Meanwhile the colony that succeeded, by taxing itself, by mortgaging the future, or by any other process, in constructing the greatest railway mileage relatively to its area and population, was likely to have the best start in the race that our colonies must hereafter engage in for supremacy at home and commercial intercourse abroad.

In discussing the paper of Mr. Jeans the Chairman, Mr. Mundella thought that the author took a very heroic course in recommending the colonies to plunge so deeply into debt for their railway extension; he did not doubt the ultimate advantages of these extensions in developing the colonies but suggested that some of them at least seemed to have as heavy a load already as they could conveniently bear. Mr. Jeans in reply said that for one New South Wales was borrowing money at 3½ per cent. while her railways were earning from 4 to 4½ per cent. and that practically the colony was making a profit at the same time that it was developing its territory.

Mr. Price Williams who had lately been in the colonies in connection with their railway extensions agreed with Mr. Jeans in his remarks that so long as the railway communications of these colonies remained incomplete and inadequate, just so long must England withhold from these sections the 30 millions sterling which she now pays annually to the United States. He found the climate and soil most favorable to the production of superb crops, and all that was lacking was English capital and Englishmen to take advantage of what nature has provided.

Other speakers followed in a discussion of the methods of construction best adapted to new countries as to broad and narrow-gauges; but the bulk of the evidence was against the narrow-gauge. Mr. Carbutt suggested to his colonial friends they could construct their roads cheaper now than ever before, when steel rails were made for £3.12*s.* 6*d.* ($17.60) per ton.

The contract for building a new wrought-iron bridge across the Schuylkill for the Philadelphia and Reading Company has been given to the Phœnix Iron Company.

Steel Sleepers for Collieries.

The Tredegar Iron & Coal Co., of England, are now introducing a special steel sleeper for use in collieries and under-ground workings. The great sums annually expended in the maintenance of the present system has long called for improved methods, and the steel sleeper has been introduced to this end.

The Tredegar pattern is a strong, light, "corrugated" sleeper with a special clip fastening for the rail patented by Mr. James Colquhoun the general manager of the company named. The clips are put in after the sleeper is laid and the rail keyed up with a slender steel key. This sleeper has now been imployed for some time in collieries where there were sharp curves and steep grades, and it has given great satisfaction.

Gold in the Transvaal.

The *Colonies and India* states that there is great activity in developing the Transvaal gold fields, the headquarters for which are at the new mining town Barberton. Placer mines have been successfully worked for some time but now attention is directed to the reefs of quartzite.

The mining machinery so far imported, mostly made by Sandycroft and Robey & Co., is all English, and this seems to offer an opportunity for our Eastern and California manufacturers, particularly as at present most of the miners are Boers, who will not have the prejudice against anything American that the English have.

The Delagoa Bay Railway, the plans for the building of which we have noticed from time to time, though not commenced, is opening a freight line over its route that is already threatening to do the business of the Transvaal and neighboring countries, 150 tons of gold mining machinery having been landed at Delagoa Bay.

Municipal and Sanitary Engineering in the City of London.

The city of London which, is a small patch of four hundred and thirty four acres, on the area of the great metropolis, is fortunate in the possession and long retention of Col. William Haywood as Engineer to the "Hon. the Commissioners of Sewers." His annual reports are always interesting, while some of his special reports are quoted as standard authority on the subjects treated. The annual report for 1885 covers nearly all the subjects in which a municipal engineer is interested, and embraces the following subjects:

SEWERS.

Four hundred and seventy-two feet constructed, of which 320 feet were on lines of old sewers. Pipe ventilation is in use in 159 places, in all of these cases the ventilating gratings were removed from the roadway. The resolution of the commission, September 1884, that ventilating flues should be carried up in party walls of new buildings was enforced in one instance; these are apparently built at public expense.

Two hundred and eleven premises were drained as is shown by 131 plans prepared and deposited in the Engineer's office.

DANGEROUS STRUCTURES.

To the number of sixty-nine, were reported. Of these, two cases were "heard before the magistrates" and 66 shored up or certified as completed.

IMPROVEMENTS.

About sixteen out of fifty-nine pages are devoted to reports under this head on widening and straightening streets, canting and rounding angles, and removing projecting stoops, walls, etc. For example, "This improvement in Little Britain after protracted negociations and some unavoidable delay in dealing with the parish and ecclesiastical authorities, was completed, the street widened and the surplus land agreed to be sold to the parish of St. Botolph, Aldersgate, who hold the land adjacent."

"The sites occupied by St. Paul's Schools and the adjacent buildings next to Watling street, being pulled down, arrangements were made with the freeholders, (the Mercers Company) for the removal of the piers, and the building above them, which projected over the public foot way at that spot. Shortly afterward an arrangement was made by which the frontage of the house at the angle of Watling street, which projected far beyond the school front is to be set back about 7 feet 3 inches, and the angle canted. Portions of the areas in front of the school buildings are to be given up to the public in exchange for an area of the public way, which from its position, was of little or no use to the traffic."

Many of these improvements consisted in widening thoroughfares so that two vehicles can pass instead of one. These proceeding are prosecuted with deliberation, the report for 1876 showing that the widening of Newgate street was completed 41 years after its commencement. The London practice of canting and rounding angles as shown in Figs, 1 and 2* with the addition of refuges or resting places at the crossings is one that should be introduced not only into this city, but the practice is recommended to the attention of engineers and surveyors laying out new towns. Travel is always slower and somewhat congested at crossing and the widening of the wheelway at those, points, expedites its movement gently, while the refuges besides keeping the traffic on its proper side of the street by the aid of signs reading, "Keep to the Left," are of great convenience to persons crossing as they have only to watch the stream of traffic leading in one direction, between the foot-way and refuge, which is generally raised about the same height from the street, as the curb, and may be 4 or more feet broad and some 2½ to 3 times its width in length. Another consideration in favor of the rounded corners is, that they present opportunities for ornamental façades that add to the beauty of the city. Either canted or rounded corners at the intersection of Broadway and Fulton streets with proper refuges, would add to the speed of traffic and would be of great convenience to pedestrians.

PAVEMENTS.

The pavements of compressed asphalte in the city of London are probably the best in the world, and none, it is thought, are cared for so thoroughly or kept cleaner.

Twenty nine streets or parts of streets were relaid during the past year.

With Compressed Asphalte.

Val de Travers (or Neuchatel)	4
Limmer Compressed Asphalte	11
Asphalte of the Societé Français des Asphalte (Seyssel)	2

With Wood.

Improved Wood Pavement Co.	1
Mowlem's Wood Pavement	2

With Granite.

Laid with redressed blocks	9

No areas are specified, nor are any exact data at hand, showing the areas paved or the quantities of different pavements laid. From 1873 the practice seems to have been not only not to buy additional granite but to sell the surplus that accrued from the introduction of asphalte and wood, or as called in the reports *noiseless* pavements, and in the report for 1877 we find "As most of the main streets of the city are now paved either with wood or asphalte, and other further extension, of noiseless pavements seems probable, a large reduction was made in the number of the men who for many years have been employed by the commission in stone dressing."

In 1878 the lengths of different noiseless pavements is given as follows:

	Length Yards.
Of Compressed Asphalte	9,688
" Mastic	1,611
" Wood	11,164
Total	22,463

Since that, thirty different pieces have been laid with Val de Travers, twenty-seven pieces by the Limmer Co.; eight by the Society Française and one by Mr. Stiebel who uses either Seyssel or Sicilian Rock, or seventy two in all. All of those were with *Asphalte Comprimé* and some were to replace the mastic mentioned above.

Wood pavements have been replaced by compressed asphalte but no mention is made of asphalte being replaced by wood or granite It is now claimed that "in the city," where speed of circulation and freedom from noise are so important, about half the area of the streets are laid with compressed asphalte; outside of the city very little is laid except along Holborn and Oxford street. The area laid in all London during the last year by one company, the Val de Travers, was 24,717 square yards in roadways and 18,818 square yards in footways.

The following note is given on wood pavers:

Nearly all the contractors who have laid wood pavements in the carriageways of the city during the last thirteen years have, with the exception of four, either become bankrupts, or failed to carry out their contracts, a result probably attributable to their having taken work at prices at which they could not execute and maintain it at a reasonable profit.

Most of the wood pavements mentioned were laid on a concrete foundation, some with felt, some with bitumen intervening. The joints were filled with felt, bitumen, grout or a combination of the two last. A more or less full discription can be found in the Transactions of the American Society of Civil Engineers, 1879, and in those of the Institution of Civil Engineers, Vol. 58. Their cost was from $3.90 to $4.83 per square yard. They were in general to be kept in repair for two years free of expense to the city and for fifteen years afterwards at from 18¼ to 36½ cents per square yard per annum; a good pavement being turned over at the end of the seventeen years. A fair sample of the wood pavements laid in London can be seen on Fifth avenue, in this city, between Thirty-second and Thirty-third streets. This style of pavement is very popular in the "West End" or residence part of London, and when kept in good repair is worth its cost. Twenty footways were relaid.

With Val de Travers compressed asphalte	1
With Limmer compressed asphalte	2
With dressed York stone and cerb from City Stoneyard.	17

Compressed asphalte which here, probably on account of the variations in temperature, cracks too much, is used all over London for sidewalks as well as in the city. York stone is a red sand stone and is usually laid in pieces from 2 to 3 feet square.

STREET LIGHTING.

Gas is burned in London street lamps 4,300 hours per annum, against 4,000 hours in this city. The contract charge was at the rate of 2 *s.* 6*d.*, or 60 cents, per 1,000 feet. The demand for residuals, such as gas-tar and ammonia water, in England being so much greater than here, that at times the gas is said to bring less than the by-products,

*Cut damaged. Will be shown in next issue.

Two styles of lanterns are used, circular and square and two sizes of burners, one burning 5 feet per hour and the other 10. The cost of gas is $13.05 or $26.10, of lighting $3.60, and of cleaning and repairing square lanterns 72 cents, circular $1.74, so that the cost per lamp may vary from $16.37 to $31.44. In this city 3-foot burners are used and the costs per lamp per annum vary with the company contracting, as follows: $12, $17.50, $25 and $30. $4 of the above is for cleaning the lamps. The payment for electric lights is 70 cents per night, and for naptha lamps $25 per annum. The total number is not given, but "two additional ones were erected." The following quotation shows a commendable desire for appearance.

The lanterns should be cleaned three times a week, and I submit that it is well worth the while of the Commission to make an early arrangement with the gas company accordingly. Dirty street lanterns not only obstruct the light, but give street a neglected appearance.

As this plea for clean lamps has appeared about twice every three years, it does not seem that the city fathers share in the Colonel's feelings on the subject.

Though in matters of paving, and in street sanitation generally the Londoners are far ahead of us, they are woefully behind in electric lighting, which fact is "solely attributable to the operation of the Electrical Lighting Act." The parts of this act complained of are the 27th clause; which enacts that at the conclusion of twenty-one years after the company acquires its charter, the local authority can compulsorily take over the undertaking simply on paying the then value of the works, plant etc., without allowance for good will, disturbances, profit, or any other valuable pertaining thereto; and the 18th section which prohibits undertakers from prescribing any form of lamp.

These two provisions have almost entirely prevented the development of electric lighting in England, and there are now three bills before Parliament which in effect lengthen the time for acquisition by local authority and provide for arbitration on the value of the works "as a going concern."

The passage of either of these amendatory bills would lead to a large exportation of electric light plant from this country, as we are far ahead of other countries in this manufacture.

It will interest gas superintendents to know that one argument urged against the institution of an electric plant by the city is "The Commission will also be at once in competition with the gas company, who will probably reduce the price of gas to one half what it is at present or even less"!

PUBLIC URINALS.

An observant traveler has asserted that the state and condition of a country's privies afford the readiest index to the state and condition of its civilization. The remark was made by an American before the occurence of a few sporadic cases of public urinals now found in one or two of our cities, and their absence was not noted as affecting civilization. Anglo-saxons are indebted to the Latin races for these aids to, if not necessities of public decency, and it is to be hoped that they may yet become as common in this country as in England, so common that the beer saloon will not be the only haven for the wayfarer.

The years report that chronicles the construction of 472 feet of sewer, 252 feet of which was new, and the erection of two additional gas lamps, mentions the building of four new urinals with 25 compartments and 4 water closets; the enlargement of 1 urinal to 12 and another to 20 compartments with six water closets and the determination to build three additional ones. Some of these urinals are built in side streets, others in open or broad spaces, but the larger number are underground; for instance, "This structure is now in the course of formation, and will include four water closets and nine urinals, together with the usual room for attendants, stores, etc., etc. The surfaces will form a place of refuge for pedestrians crossing the carriage ways." "The whole is amply lighted by ornamental iron gratings, filled in with glass pavement lights which form the footway above. Ventilation is afforded by iron gratings at the level of the footways and also by means of shafts carried up the iron columns. The structure is lined throughout with glazed bricks, the doors and joiners' work being of pitch pine and no expense has been spared to make the building as complete as possible. It has been found best to charge one penny (two cents) for the use of the water closets, the free use having been abused." On the Continent a charge for the use of these public conveniences is almost universal.

Besides these public convenience which apparently number forty-five with about 240 compartments there are several *Chaletcs*, erected by private parties in roadways where the urinals are free, but a small charge is made for the use of water closets and toilet convenience, they are for both men and women, and the sides are used for displaying advertisements.

(TO BE CONTINUED).

OBITUARY.

E. S. Chesbrough, Civil Engineer.

(With a Portrait.)

ELLIS SYLVESTER CHESBROUGH, Past President of the American Society of Civil Engineers, who died at his residence in Chicago, on August 18, 1886, was born in Baltimore county, Md., July 6, 1813. In 1828 the Baltimore & Ohio R. R. Co. was engaged on the preliminary surveys of its line, and young CHESBROUGH found employment in one of the parties as chainman. He was a favorite with the engineers in charge of the surveys, from the first, and by them was encouraged and assisted in his upward career as a civil engineer. Although of delicate physique and apparently unable to withstand the severe hardships incident to his chosen profession, young CHESBROUGH was always "on time," and like many another man of strong will, combined with cheerfulness, intelligence and patience, he survived the hardships of his early surveying experiences while stronger men dropped out by the way. The boy was a willing assistant and an apt learner and mastering the elementary work of railroad surveying, was quickly advanced so that, in his second year of service, he occasionally was in charge of a party.

In 1830 MR. CHESBROUGH was appointed assistant engineer on the Allegheny Portage R. R., then being surveyed by Col. Stephen H. Long, of the U. S. Topographical Engineers, and at that time a leading engineer of the country.

In the summer of 1831 MR. CHESBROUGH became Assistant Engineer under Capt. Wm. Gibbs MacNeill of the Topographical Engineers, and then Chief Engineer of the Paterson and Hudson R. R. now the southeastern division of the Erie R. R., and in that year located nearly the whole of the road, besides making preliminary surveys for a line from Jersey City to Newark, N. J. From 1831 to 1836 MR. CHESBROUGH was engaged under the same Chief Engineer in the location and construction of the Boston and Providence R. R., and on the surveys of the Taunton and New Bedford R. R.; also in this latter year he was appointed resident engineer of the proposed railroad from Lowell, Mass., to Concord, N. H., his immediate chief being Mr. Geo Whistler, afterwards appointed by Emperor Nicholas of Russia, Consulting Engineer for the St. Petersburg and Moscow R. R. in which service he died.

From early in 1837 to the middle of 1842, MR. CHESBROUGH was engaged in railroad construction in South Carolina and adjacent states, as Senior Assistant Engineer under Major McNeill, on the surveys and construction of the Louisville, Cincinnati and Charleston R. R. Among the engineers of the corps over which MR. CHESBROUGH was placed in command were the afterwards eminent J. P. Kirkwood; Alfred W. Craven; Gen. Geo. S. Greene, and Gen. Jno. C. Fremont.

The financial panic of 1836 brought every railroad enterprise to a stand still and for the first time in many years MR. CHESBROUGH was entirely out of employment. He improved the opportunity, however, by going into the shops of the Providence and Stonington R. R. and learning the practical use of tools; then he tried farming in Niagara county, N. Y., and like many other talented men—failed.

In 1844 he was again railroading and in succession located and constructed the Stoughton branch of the Boston and Providence R. R., located a line between Ashburnham, Mass. and Brattleboro, Vt. and was engaged on the construction of the Pawtucket branch of the Boston and Providence R. R., when, in 1846 he was surprised with an invitation to become Chief Engineer of the Western Division of the Boston Water-Works.

Realizing his lack of knowledge of hydraulic engineering, MR. CHESBROUGH was averse to accepting the proffered situation, but being urged by his friends, the Water Commissioners, and knowing that he would have the assistance of Mr. John B. Jervis as Consulting Engineer, he accepted. The construction was more difficult than had been expected but in 1849 the works were completed. In that year upon the invitation of the Provincial Secretary of Nova Scotia, MR. CHESBROUGH visited that province to advise concerning the proposed railroad between Halifax and Windsor.

In 1850, MR. CHESBROUGH was made sole Commissioner of the Boston Water-Works; in 1851, the Cochituate Water Board consisting of seven members was created, and MR. CHESBROUGH was appointed the first City Engineer of Boston, and as such, had charge of all water-works under the Cochituate Board, besides attending to the other duties of his office. During these years he investigated the English system of sewerage and upon his report it was introduced into this country for the first time.

On October 1, 1855, he resigned his office as City Engineer of Boston to commence his great work of providing Chicago with a system of sewerage, to which problem he had been invited by the Chicago Board of Sewerage Commissioners. In the winter of 1856 and 57, he visited Europe, and having made a careful study of the principal systems of sewerage there, made a report thereon in 1858. This report is now unobtainable, but is always in demand as a standard contribution on the subject of sewerage to which very little new information has been added by later writers. The systems of sewerage and water supply for Chicago recommended, were carried out by the Chicago Board of Public Works—the sewerage, being placed under the immediate direction of Mr. Wm. H. Clarke, Assistant Engineer, who died in 1878. MR. CHESBROUGH'S connection with the construction was merely

nominal; his chief duties were in planning and constructing the water tunnels, sewer tunnels and harbor protection. To him was due the conception and construction of the entire water-works scheme by which Chicago is supplied with abundance of excellent water.

MR. CHESBROUGH was City Engineer of Chicago up to the beginning of the term of the present Mayor Harrison, when he resigned. In 1879 he was appointed to the newly created office of Commissioner of Public Works which he resigned at the same time as the other office.

MR. CHESBROUGH, in addition to his other labors found time to advise in projects for tunnelling the Detroit river; to plan the Fullerton avenue Conduit in Chicago: the Sewerage of New Haven, Conn.; Water works for Pittsburg; Sewerage for Indianapolis; Water works and Sewerage for Milwaukee; Water works for Jacksonville; and also for Akron, O., he was also Consulting Engineer on Water works questions for New York City; Boston; Cambridge, Mass.; Toronto: Detroit and Memphis; and in Sewerage for Boston, Providence, Memphis, Peoria, Dubuque, Des Moines, Burlington, Ia. and Chattanooga, Tenn.

In 1880 when the subject of the extension of New York City Water Supply came up MR. CHESBROUGH was consulted, and permanently appointed as Consulting Engineer to the Department, and aided Mr. Newton, the Chief Engineer, by his counsel and advice in the surveys and preparation of the plans as presented by him. The Quaker Bridge Dam, which is of unprecedented magnitude, formed part of this plan, and MR. CHESBROUGH, in December, 1882, went to Europe and spent several months in the examination of the high masonry dams in Southern France and Spain. His reports, on his return in the Spring of 1883, formed the basis upon which this dam was designed. This was the last work upon which he was engaged, as his health forbid active exertion.

A high and lofty view of personal honor, and the requirements growing out of an intense and abiding sense of his whole duty as a Christian man, and his accountability as such gauged every action of his life from the least to the greatest. Though of a mild and amiable temperment he possessed a courage to face both moral and physical obstacles based upon this deep feeling of reliance upon his God; and this religious sentiment formed the keynote to his character in all his relations, whether social or professional.

His position as an engineer was well assured—no one stood higher in his profession in our country. A great student to the last—though owing but little to early teaching, he mastered, by close and unremitting study, the entire field of general literature, as well as that of his chosen profession. Extremely modest in the expression of his opinions, he was careful to avoid any appearance of the assumption of superiority, and unless the sense of duty, which was so paramount with him, impelled—he shrunk from exposing even the pretensions of the quacks in his profession. He was largely consulted, and his advice always regarded as the conscientious convictions of a truly honest man and a Christian.

PERSONAL

MRS, ADA VAN AUKEN, wife of ex-City Engineer CHARLES VAN AUKEN, of Cohoes, N. Y., died of consumption, aged 30 years.

F. B. LOCKE has been appointed Engineer of Maintenance of Way on the State R. R. (Fitchburg R. R.) in place of H. B. Potter, who resigned.

T. FITZGERALD, of the Baltimore and Ohio Railroad, has been promoted from Superintendent of the Trans-Ohio Division with head-quarters in Newark O., to the Superintendency of the main line, with head quarters in Baltimore. The appointment takes effect September 1st.

C. N. INGALLS of Jamestown, Dak., died suddedly August 8th at Hawley, Minn., where he was in charge of the bridges and construction of the Duluth & Manitoba R. R. Mr. Ingalls built the hotels in Yellowstone Park, and was long identified with the Northern Pacific R. R. construction.

MR. J. P. KNIGHT, General Manager of the London, Brighton & South Coast R. R., in England, died at the age of 58 years last month. He was many years in the employ and at one time Superintendent of the Southeastern Railway Co.

I. M. DE VARONA, Engineer-in-Charge of the Brooklyn Water-Works Extension, has been appointed Consulting Engineer to the Albany, N. Y., Special Water Commission. The scheme to be considered is the daily supply of ten millions of gallons, to be obtained by the gang-well system of Messrs. Andrew & Bro.

GENERALS DUANE, ABBOTT and COMSTOCK, and COLONELS HOUSTON and MCFARLAND compose a board of engineer officers at New York, which has been ordered to Washington to examine and report upon the new tunnel of the Washington aqueduct to determine what kind of lining it should have. This is in accordance with the provisions of the General Deficiency bill.

CIVIL ENGINEERS OF IOWA.—A number of civil engineers of various places met in Cedar Rapids recently, and completed the work they had on hand for a year or more, that of organizing the Society of Civil Engineers of Iowa. The society contains about twenty-five good, brainy, active men, three of them occupying official positions in Iowa cities, the remainder employed in railroad and special work, and will, by another year, probably contain twice that number. Mr Steyh, city engineer, of Burlington, has been one of the active men in this movement and was placed on the executive committee.

SIR JOHN ANDERSON died at his residence in England on July 28, aged about 72 years. Sir John commenced life in the Engineering department of a cotton mill, and in 1842 was put in charge of the brass gun foundry at Woolwich Arsenal. He there introduced many improvements and reforms, invented a bullet machine with a capacity of 40,000 bullets per hour and reducing the expense from 5s. per thousand to 5¾d. In 1853 he was chiefly instrumental in changing the methods of the manufacture of rifles at Enfield substituting machinery for hand-labor. In 1859 he superintended the government manufactury of Armstrong guns and was made Inspector of machinery with a salary of $6,000. He was knighted in 1878 in recognition of his services as a juror in the exhibition at London, Paris, Vienna and Philadelphia.

JAS. W. MCCULLOH.—Corporation Counsel Lacombe furnishes the following indorsement to the worth of the late Secretary of the New Croton Aqueduct Commissioners.

"It gives me great pleasure to have the opportunity of testifying to the faithfulness and efficiency with which those duties have been performed. From the date of your appointment I have been, both as Assistant Counsel to the Corporation and subsequently as the head of the Law Department, thoroughly informed as to the manner in which you have discharged the functions of the office of Secretary so far as the duties of that office were concerned with matters of which the Law Department has had cognizance. The questions of law arising out of the administration of their concerns by the Aqueduct Commissioners have always received my personal attention, and I have thus had occasion to meet you with greater frequency than I have most other officials holding similar positions in the different departments of the City Government. From the date of our first meeting until now I have been strongly impressed with your absolute fidelity to the interests of the City of New York, a fidelity which has been especially beneficial to the city from the circumstance that, either by natural intuition or from past experience, you seem to appreciate in a higher degree than do most laymen the absolute necessity in discharging a statutory trust of adhering with the greatest circumspection to all the requirements of the statute.

"Upon the many occasions when I have had to apply to you, either personally or through the assistants of this department, for information touching the affairs of the aqueduct, the response has always been so prompt and complete as to indicate a thorough understanding upon your part of all the details of that work. In all the steps which heretofore have been taken looking toward the acquisition of property rights your past experience in the acquisition of similar rights elsewhere and your thorough familiarity with all negotiations and attempted negotiations for the acquisition of such rights on the line of the aqueduct since the organization of the commission have been entirely at the disposal of the Law Department, and, I am satisfied, with beneficial results.

"Your efforts in behalf of the city seem not to have been limited by any narrow conception of your duties. In illustration, it is only necessary to refer to the description of parcels sought to be acquired under the last proceeding. These, as you will remember, were prepared in the engineers' department. Naturally, the engineers were concerned solely with accuracy of description, not appreciating the necessity of succinctness. No obligation rested upon you, as Secretary, to do more than transmit them to this department; but I well remember the occasion of such transmission, when you suggested that if you might be allowed to take them home for two or three nights, you could, by reason of your entire familiarity with the location of the property and maps, so re-arrange the descriptions as to materially reduce their dimensions without a sacrifice of accuracy. This you did, and by the voluntary assumption of a laborious task so reduced the length of the published notice as to save in the expense of advertisement an amount equal to your entire annual salary. Your zeal and fidelity at all times, in season and out of season, must be apparent to any one who has been at all familiar with the manner in which your duties have been discharged during the past three years."

CORRESPONDENCE.

Compliments.

CHAMPAIGN, ILL., August 9, 1886.

EDITOR ENGINEERING NEWS:

I have been intending for some time to say that I think you are making a *mighty* good paper. I frequently hear the same opinion from others too. Allow me to congratulate you.

Yours very truly,
I. O. BAKER.

Engineer's Surveying Instruments,—Their Construction and Uses.

II.

Written for ENGINEERING NEWS.

BY I. O. BAKER, C. E. PROFESSOR OF CIVIL ENGINEERING UNIVERSITY OF ILLINOIS.

THE TELESCOPE.

1. A telescope consists, optically, of certain lenses which assist the eye in seeing distant objects; and, mechanically, of certain parts which facilitate the use of the opitcal parts. The mechanical parts can best be discussed in connection with the instrument to which the telescope is applied, in the present chapter only the optical parts will be considered.

No attempt at an elaborate discussion of the theory of the optical workings of the telescope will be made, but attention will be confined to such points as are needed by the engineer for the intelligent use of his instruments.

2. CONSTUCTION. There are two forms of the simple refracting telescope, usually known as the Galilean, and the astronomical. The last term is not a happy one, and *measuring* is suggested as being more appropriate, as will appear farther on.

The Galilian telescope consists of a double convex lens, called the object-glass, or simply objective, placed next to the object, and a double concave lens, called the eye-piece or ocular, placed near the eye. This form shows the object erect; an opera-glass is a good example.

The chief purpose of the objective is to increase the amount of light which reaches the eye from the object viewed. Sole object of the eye-piece is to magnify the thing looked at. The above form of telescope then assists the eye by its magnifying and light gathering power; but such a telescope would be useless for making precise measurements, since there

is no means of indicating the exact point at which the telescope is sighted. It would not be inappropriate to call it a *seeing telescope*. The first telescope was of this form and took its name from the inventor, Galileo.

The *measuring* telescope consists of three essential parts: 1, a convex objective, which collects the rays of light and forms a bright inverted image of the object; 2, a convex eye-piece which is essentially a microscope, for viewing the image formed by the objective; and 3, two fine wires or spider threads, placed in the plane of the image, the intersection of which indicates the precise point sighted at. The objective collects the light, the eye-piece magnifies, and the cross-hairs indicate the point at which the telescope is directed. If such a telescope neither magnified nor increased the illumination, it would still be of great advantage in making measurements. This form shows the object inverted.

Both of the above skeleton forms of telescope are very imperfect. The methods of improving the optical qualities of these elementary forms will now be considered.

3. Objective. A single lens used as an objective has the following defects. 1. The rays of light, which traverse a spherical lens near the edge, are refracted to a point nearer the lens than the rays which pass through the central portion; consequently the image is blurred. This deviation of the rays forms the focusis call spherical observations. 2. Rays of white light, after being separated by a single lens, are resolved into the colors of the prismatic spectrum ; consequently the image will be disfigured by colored light. This deviation of the different colored rays is called chromatic observation.

The objective of a telescope is rendered almost free from these defects by substituting for the single lens, a compound one, composed of a double-convex crown glass, and a concave-convex flint glass lens; the two components have different refractive and dispensive powers, and by giving the four spherical surfaces proper curvatures, these defects are nearly eliminated.

Eye-Piece. A single lens used as an eye-piece possesses the same defects—spherical and chromatic aberration—as when used as an objective, but in a less degree. An eye-piece as a single lens has also the following defects: 1. The image of a flat object formed by a lens does not lie in a plane, but is concave towards the lens. This deviation of the image from a plane is termed aberration of sphericity, which is wholly separate and distinct from spherical aberration. The objective possesses this defect, but in so slight a degree as to be inappreciable; but in an eye-piece of a single lens, it is very serious. 2. A telescope with a single lens for an eye-piece has a limited field of view.

In both forms of telescope, the chromatic and sperical aberrations, and the aberration of sphericity are nearly eliminated by substituting two plane-convex lenses for the single lens, which also increases the field of view.

Huggben or Negative Eye-Piece.—This is a modification of the concave eye-piece of the Galilaen telescope. It consists of two plane-convex lenses with their convex sides turned towards the objective. The relations of the eye lenses to each other, and to the objective, are shown in Fig. 3.

P is the object; *O*, the objective; *A* and *b* constitute the eye-piece which is placed between the objective and its principal forces; *F a* is known as the field lens, and *b* as the eye lens. The large arrow at *I* represents the object as it appears through the telescope, the small one representing it as it would appear without the instrument. The angle which the large arrow at *I* subtends at the eye divided by the angle which the object subtends at the eye is equal to the magnifying power; that is, the magnifying power is equal to the ratio of the larger arrow at *I* to the small one.

R msden or Positive Eye-Piece. This is a modification of the convex eye-piece of the measuring telescope. It consists of two plane convex lenses with their flat sides towards each other. The relations of the eye lenses to the objective are shown in Fig. 4.

The nomenclature is as before. Notice that the eye lenses are farther from the objective than its principal focus. The objective forms an image at *F* which is viewed with the eye-piece. The magnifying power is the ratio of the two arrows at *I*, as before.

Notice that the essential difference between the positive and negative eye-pieces is that only with the former is a real image of the object formed, and hence it is the only eye piece with which cross-hairs can be used. Spider lines are sometimes placed in negative eye-pieces, for example in sextants, simply to indicate the middle of the field of view; they are but indirectly concerned in the accuracy of the observations. The negative eye-piece is better for simply seeing, while the positive is absolutely necessary for making precise measurements; the latter is always used in transits, levels, etc. Modifications of Ramsden's eye-piece, are frequently used which consist in the substitution of compound lenses instead of the single lenses shown in Fig.

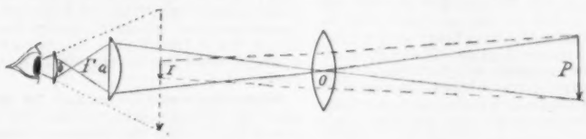


Fig. 3.

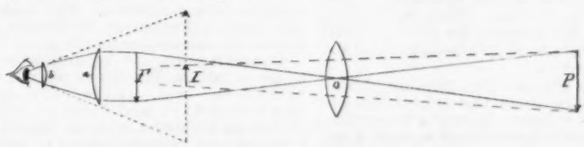


Fig. 4.

8. Erecting Eye-piece. The erecting or terrestial eye-piece, in its most elementary form, consists of a convex lens placed between the eye and eye-piece of the measuring telescope, which inverts the image formed by the objective and shows the object erect. In its common form, it consists of a pair of plano-convex lenses, instead of the single lens as above; this pair is called the erecting piece.

The erecting eye-piece is inferior to the Ramsden or inverting eye-piece, owing to the loss of light occasioned by the two extra lenses. The inconvenience of the inversion of the object is easily overcome with a little practice. Furthermore, other things being equal, the telescope is shorter with inverting eye-piece; this is quite an important advantage in the transit. Most of the American engineering instruments, have an erecting eye-piece; but it would be a great improvement, if all were provided with the inverting eye piece. It is said that the inverting eye-piece, is more common in Europe than America.

Telescope Slide. To assist in focusing the objective for different distances, the object glass is fastened in a tube which slides, with a rack and pinion, into the end of the main tube of the telescope. In instruments, provided with an inverting eye-piece, the objective is fixed and the cross hairs and eye-piece move together, to and from the objective. It is immaterial which form is used, the principal is the same in both, it is only important that the slide shall be straight and fit snugly.

To facilitate the focusing of the eye-piece upon the cross-hairs, the ocular is provided with a similar slide. In some instruments the ocular is moved by a rack and pinion; but this is unnecessary and even worse than useless, for, having once adjusted the ocular for distinct vision of the cross hairs, it needs no change except for different observers, and it is better that it should not be easily moved. If no rack and pinion is provided, the ocular is moved in and out by hand with a screw-like motion.

Cross Hairs. There are usually two spider threads, one vertical and the other horizontal, fastened to a ring which is adjusted in the tube by three or four screws. Lines ruled or etched upon a piece of thin glass, are sometimes used. The cross hairs are sometimes made of very fine platinum wire, these can be drawn to the required fineness only by being previously surrounded by silver, which is removed by acid after the wire is drawn. Both spider threads and platinum wires have their advantages or disadvantages, and as a consequence, their advocates and opponents.

For the platinum wires, it is claimed that they are best because they are opaque; this is a desirable property when the cross-hairs must be illumined as in astronomical and mine surveying. Spider lines, particularly dark colored ones, can be illumined pretty well. It is claimed also that wires are unaffected by the humidity of the atmosphere, and hence the line of collimation is not liable to change from this cause, but this advantage does not exist if the spider threads are properly stretched. Spider threads, on account of their fineness and cheapness, and the facility with which they are applied, will continue in the future, as in the past, to be used almost universally for cross-hairs in engineering instruments.

Stretching the Cross-Hairs. It does not require much time or skill to replace the cross-hairs, the belief of many to the contrary notwithstanding. The ring which carries the cross-hairs can be taken out, having first taken out the eye-piece, by removing two opposite screws, and inserting a soft wooden stick of suitable size into one of the holes thus left open in the ring, which is turned sideways for that purpose, and then removing the other screws. Two scratches, at right angles to each other, will be found upon the face of the ring, into which the hairs are to be fastened.

The best spider lines are those of which the spider makes its nest. These nests are yellowish-brown balls which may be found hanging on the shrubs, etc., in the late fall or early winter. When found the nest should be torn open and the eggs thrown out; if this is not done, the young spiders when hatched will eat the threads. The fibers next to the eggs are to be preferred owing to their darker color.

Draw out a single fiber and attach each end of it to as heavy a tack, brad, etc., as experiment shows it will support. Dampen the thread by breathing upon it, by holding it in a current of steam, or better, by dipping it in hot water. Support the ring in such a way that, when the thread is laid across it, the weights may hang freely down the sides, thus stretching the thread. The thread may be moved easily with a pin, and when in the proper position it can be fastened with wax, gum, etc., shellac varnish is the best for this purpose. The main point is to stretch them thoroughly and fasten them tightly. If the work is well done, the threads will remain straight, when the reticule is placed in a current of steam or even in hot water.

12. TESTING THE TELESCOPE. In buying an instrument it is very desirable to test the optical qualities of the telescope; the following directions are sufficient for the examination of any telescope.

Chromatic Aberration To test for chromatic aberration, focus the telescope upon some bright object, either a celestial body or a white disk; then move the object-glass slowly in and out. If, in the first instance, a light yellow ring is seen at the edge of the object, and in the second a ring of purple light, the object glass may be considered perfect; this proves that the most intense colors of the prismatic spectrum, orange and blue, are corrected.

13. SPHERICAL ABERRATION. To test this, cover the object-glass with a ring of black paper, so as to reduce the aperture about one-half; focus on some small and well defined object for distinct vision. Remove the ring of the paper and cover that part of the objective previously left open; then notice how much the object-glass must be moved in or out for distance vision. The amount of shift measures the spherical aberration of the objective; very little if any motion should be required to obtain a distinct view. Another test is to focus sharply upon some object, where the least motion of the objective should render the object in distinct. This last is not so good a test as the former, for the eye will change focus slightly to accommodate itself to the change of distance.

14. FLATNESS OF FIELD. The flatness of the field depends mainly upon the aberration of sphericity of the eye-piece. To test a telescope in this respect, draw a heavy lined square, 6 or 8 inches on a side, on a sheet of white paper and fasten the paper to a flat board. Place this object at such a distance that the square shall nearly fill the field. Focus the telescope on it; then, if the sides appear perfectly straight, the telescope is perfect in respect to flatness of field.

A telescope which distorts the image perceptibly causes no error in common use, but it is decidedly objectionable for stadia measurements, where two points of the field are used at the same time.

15. SIZE OF THE FIELD. By the field of view is meant all those points which are visible at the same time through the telescope the field of view depends upon distance between the objective and the image, and upon the diameter of the lenses of the eye-piece; it is independent of the size of the objective. Of course the wider the field of view the better, since width of field facilitates rapid working. The greater the magnifying power the less the field of view.

To determine the angular width of field, sight upon a rod, house, etc., and mark two opposite sides of the field; the distance between these points multiplied by 57.3 and divided by the distance from the rod to the objective is the angular width of field in degrees. Since the field varies with the distance, the latter should be stated.

16. APERTURE OF OBJECTIVE. By the aperture of the objective is meant the effective diameter of the object-glass, that is, that part of the objective which transmits light which finally reaches the eye. Usually diaphragms are placed in the tube of the telescope, with a view to improve the optical workings of the lines, if the diaphragms is placed near the object-glass, it will cut off those rays which pass through the objective near the edge, thus improving the definition, without diminishing the field, but with a loss of illumination. If the diaphragm is placed in or near the eye-piece, it may diminish both illumination and field of view.

To find the real aperture, direct the telescope towards the sky, place a pointer in contact with the objective so that the pointer may be seen in the small illuminated circle which will be noticed at the small opening of the eye-end when the head is drawn back a short distance from the telescope; move the pointer over the face of the object-glass until the point just appears and measure the distance from the pointer to the edge of the object-glass. The real or clear aperture of the objective is equal to the diameter of the object-glass minus twice the above distance.

17. ILLUMINATIONS. The brightness of an object as seen through a telescope depends upon. 1, the illumination of the object. 2, the relative sizes of pupils of the eye and the objective. 3, the polish and transparency of the lenses, and, 4, the magnifying power. In all telescopes light is lost by reflection from the surface of the lenses, and by imperfect transparency. The object-glass transmits a certain amount of light, which the eye-piece distributes over a larger or smaller area, according to the magnifying power of the telescope; therefore, the brightness of the image varies inversly as the square of the magnifying power. Since the brightness of view is an despensable requisite of a good telescope, the magnification should never be excessively large, for it frequently happens that the telescope is used in viewing objects only faintly illumined.

Since there can be no unit by which to measure the illuminating power, of a teleseope, we can only find the relative illumination. If two telescopes are to be compared as to light, they should stand side by side and be looked through at the same time, so as to be under the same atmospheric conditions. If, as night approaches, the two telescopes be placed side by side, and the same object be viewed through each, the one through which the object is longest visible has the best illumination.

DEFINITION. The definition of a telescope depends upon the accuracy of the curvature of the surfaces of the several lenses, and upon the coincidence of the axes of the component lenses of the objective and ocular. The reader should distinguish between illumination and definition. The lack of the former causes the image to be faint, the lack of the latter causes the image to be indefinite.

To test a telescope for definition, focus upon some small, well-defined object; small, clear print is the best. If the print appears clear and well defined and fully as legible at 40 or 50 feet as if viewed with the naked eye at 6 or 8 inches (the best distance for distinct vision), the surfaces of the lenses are correct and well finished. Indistinctness may be caused by spherical aberration; therefore, that should be tested for before definition.

MAGNIFICATION. The power of a telescope, or degree of magnification, depends upon the relative focal length of the objective and eye-piece. Mathematically any power can be given to any telescope; but, in practice, it is limited by the effects of loss of light, size of field and imperfection of the lenses. For rapid work, the exact focusing necessary with high powers is a drawback, since a small change in distance requires a corresponding change in focus. The magnifying power varies slightly with the distance to the object; but, fortunately, the exact magnifying power of the telescopes on engineering instruments is not required. Several methods of measuring the magnifying power are given in Chauvenet's Practical Astronomy, Vol. I. Articles 7-13, of which the two following are the simplest.

1st Method. "Direct the telescope in daytime towards the open sky; near the eye-piece, and a little beyond it, a small illuminated circle will be seen, which is nothing more than the image of the objective opening of the telescope. Let the diameter of this circle be measured by a very minutely divided scale of equal parts; then the magnifying power is equal to the quotient arising from dividing the diameter of aperture of the object glass by the diameter of this illuminated circle." The chief difficulty in this method lies in the exact measurement of the diameter of the small illumined circle.

2nd Method. "Let a staff which is very boldly divided into equal parts of heavy lines, be placed vertically at any convenient distance from the telescope, for example, 150 feet. While one eye is directed towards the staff through the telescope, the other may observe the staff by looking along the outside of the tube. One division ot the staff will be seen by the eye at the eye-piece to be magnified, so as to cover a number of divisions of the staff, and this number, which is the magnifying power required may be observed by the other eye looking along the tube." A little difficulty may be experienced on the first trial of this method, but with a few trials it becomes very easy.

PARALLAX. This is an apparent movement of the cross-hairs in reference to the object sighted at, caused by a real movement of the eye of the observer. It shows that the image and cross-hairs are not in the same plane.

To make this adjustment, direct the telescope toward the sky, or throw it out of focus so that no object can be distinguished in the field, then move the ocular in or out until the cross-hairs can be seen very distinctly. When the cross-hairs are properly focused little specks of dust will be seen on them. Next direct the telescope to the object, keeping the attention fixed upon the cross-hairs, so that the eye shall not change focus to accommodate itself to the position of the object; move the objective in or out until the object appears very sharply defined; then move the eye back and forth sidewise and note whether the cross-hairs and object alter their relative position. If the cross-hairs appear to move with the eye, they are farther from the eye than the image, and therefore the objective should be moved nearer the object; for remember, first, that the farther object appears to move with the eye, and second that the farther the object from the objective, the nearer is the image. In practice this is more easily done by trial described. When properly focused there should be absolutely no movement of the cross-hairs with reference to the object. Of course a telescope should be accurately adjusted for parallax before it is used in making precise measurements.

The writer has incontestable evidence for believing that many of the errors of instrument work are due to parallax; this source of error is more serious as the work becomes more accurate. The difficulty is usually in not adjusting the hairs for distinct visions for the normal or natural focus of the eye. The eye perceives things best when placed 6 or 8 inches from the eye, this is known as the normal focus. When using a telescope the eye should be at the normal focus, the vision is then better and the fatigue less. The eye is continually changing focus to accommodate itself to the different distances of the objects viewed; hence care should be taken that the cross-hair focused for distant visions be at normal focus, which is secured by following the directions as above, particularly if the eye be closed for a moment before pronouncing the adjustment correct. Having secured the proper focus, it need not be changed except for the chnge of focus of the eye with advancing age and for different observers; the rack and pinion for focusing the cross hairs is worse than useless.

CARE. If the objective becomes dusty, brush it off with a fine camel hair brush, or rub it off with a piece of soft, clean chamois skin or a piece of old linen or silk, taking care to use a clean spot for each rub. Unnecessary rubbing of the lenses should be avoided, since it will destroy the fine polish upon which depends the sharpness and brilliancy of the image. Dust upon the glasses is not as objectionable as a thin, almost imperceptible film of grease; therefore, the lenses should never be touched with the fingers. When the lenses become very dirty, wash them with alcohol.

In removing the cell containing the objective, care should be taken to screw it back exactly to its former position, else the adjustment of the line of sight is thereby destroyed. The component lenses of the objective should never be taken apart, nor removed from the cell containing them, since they may not be returned to their former position, thus disturbing the adjustments. Dust should carefully be kept from the inside of the telescope tube, as it will get on the lenses and cross-hairs. When not in use the eye-piece and object-glass should be covered by their caps.

[The following definition and explanations will be found useful further along].

THE OPTICAL CENTER of a lens is, "A point so situated that any ray of light passing through it will undergo equal and opposite reflection on entering and leaving the lens. It will, therefore, be found where a line joining the extremities of two parallel radii of the opposite surfaces, the optical axis of the lens." For a double-convex lens it is always within the surface of the lens. For a plano-convex, or a plano-concave, the optical center will be at the intersection of the axis with the curved surface.

In lenses of long focal length, such as are used for the objectives of telescopes, the de-

viation caused by the thickness of the lens may be neglected, as the thickness is very small compared with the distance to the object; therefore, it is assumed that the rays which pass through the optical center are not deviated at all. This leads to the simple definition that a lens is a mathematical point which allows a great deal of light to go through it; the better the lens the more nearly is this condition realized. This "*point*" is the optical centers, as defined above.

WATER

GRAND RAPIDS, MICH., PUBLIC WORKS.—The Board of Public Works has recently issued its report for the year ending April, 1886. In the water department the earnings show a marked improvement over those of former years; the amount of water pumped during the year exceeds that of the preceding year by 33,000,000 gallons, and a saving in consumption has been effected by replacing wooden with iron mains on several streets, and by a careful inspection of the fixtures, a special inspector being employed for this work. Thirty-nine old meters have been exchanged for new ones, and eleven others put in, the total number now in use being 446. New water mains to the extent of 7,262 feet have been laid, varying from 4 inches to 24 inches diameter, with fourteen hydrants and fifteen valves. The Board strongly advocates that immediate attention be given to the question of additional supply, and recommends that no further extension of the mains be laid until such additional supply is procured; it also recommends the payment to the water department of $60 per hydrant annually by the city. The average daily consumption of water for the year is 2,046,080.93 gallons. The city surveyor has established the grade lines for 51,597 feet of streets and 2,427 feet of alleys; and street improvements have been carried out aggregating 19,622 feet in length. The sewerage system was extended 16,552 feet, mostly for laterals, including 9-inch to 15-inch pipe and 16-inch by 24-inch to 22-inch by 33-inch brick; there were also fifty manholes, and twenty-six catch basins. The entire system is composed as follows: brick, 16.253 miles; glazed pipe, 17.-904; cement pipe, .480; wood, 1.853; iron pipe in river, .160; total, 36.65 miles. The Fulton street bridge, and the Pearl street bridge were completed and opened for traffic; both were built by the Massillon Bridge Co., the specification for the latter being Theodore Cooper's Highway Bridge Specification, modified to meet local requirements: this bridge is a single intersection Pratt truss, with four spans of 144.6 feet each; the Sixth and Newbury street bridge has also been built by the same company, and work is now in progress on the approaches. The city hall is being built rapidly. The triangulation of the river, and the mapping of the work have been completed; and the dock and building lines established. The cost of the various improvements is summarized as follows: street improvements, $40,020; sewerage, $15,970; bridges, approaches, etc., $50,445.27; water mains, $17,595.77; total, $124,031.02. Mr. H. A. Collar is the city surveyor.

SOFTENING WATER.—The Corporation of Southampton (England) is improving its water supply by boring a double well into the chalk formation. These two wells are each 6 feet in diameter, bored at a single operation by a series of cutters arranged on a heavy revolving frame. The chalk removed by these cutters is raised to the surface by a circular iron "miser," the full size of the hole. This "miser" has the form of a screw, and self-acting valves retain the debris scraped up. The water from this well will be of considerable hardness and must be softened to fit it for use. The process to be employed is a modification of the well-known "Clark process." The old Clark process added certain proportions of lime water to the water to be treated and then allowed the mixture to stand twenty four hours in the precipitating tanks. The features introduced by Messrs. Atkins & Co. in the Southampton works are intended to hasten the process and obtain better results by the use of filtration instead of mere precipitation. The water from the well is first conveyed to a mixing-tank where the lime water is thoroughly incorporated with it; the treated water then passes to the "softening tank" and then to twelve of the Atkins large machine filters. These filters consist of a series of hollow filtering discs of perforated metal fixed on a central tube which forms the collector for the softened and filtered water. These discs are enclosed by a cast-iron case and revolve with the center tube during the filtering process. The discs are covered by a specially prepared filter-cloth which is renewed in six or nine months, the discs being cleaned by jets of water playing on their surface every day. The twelve machines filter 2,000,000 gallons of water per day, and the whole plant, including the two wells at £1,300, a reservoir at £4,188 and 2500 tons of pipe at £4,12s. 6d per ton, is expected to amount to £55,-000.

CORRECTION.—Our Wabash correspondent, in a late issue, stated that the contract for that place was awarded to Samuel R. Bullock & Co. at $43 per hydrant. The price was actually 100 hydrants at $45 each.

BOSTON, MASS.—Common sewers are to be constructed in Ashland street and Tremont street, Roxbury. It has also been ordered to extend the improved sewerage system to connect the intercepting sewer in Ninth street, with the sewer in O street, South Boston.

WARREN, O., WATER-WORKS.—The Council of Warren, Ohio, has just awarded a contract for the construction of water-works to Samuel R. Bullock & Co., of New York, represented by Mr. Ellis Morrison. The proposition accepted included twelve miles of water main and 100 hydrants at $45 per annum.

THE city of Newton, Mass., after a careful trial extending over a number of years is now so well assured of the value of water-meters as a waste preventor, that they have lately resolved that one be put in every house. To this end the city has ordered within the month 1,000 ¾-inch Crown meters.

PITTSBURG'S SEWERAGE AND WATER SUPPLY.—Dr. Gerner, President of the State Board of Health, has been in Pittsburg, Pa., investigating the causes of the typhoid fever epidemic on the south side. He reports the sewerage bad and the water very impure. The water was putrid, and at various places were found the carcasses of animals in advanced stages of decomposition. A run empties into the Monongahela river, which supplies the residents of the afflicted section with water. He has ordered the schinderies on its banks to suspend operations until other arrangements are made for the disposition of their refuse matter.

DRAINAGE DITCHING IN OHIO.—The farmers in this State are tiling their ditches with the following results: 1, it saves cleaning out the ditch each year; 2, saves about two rods of land; 3, saves turning the team in cultivating; 4, drives away the ditch pest—the muskrat, and 5, makes the climate more healthy. The Glade Run ditch, of which Mr. J. Axnett is engineer, comprises 10 miles of tile and 8.28 miles of open cut; but the new Strawbridge-Phifer ditch (the letting of the contracts for which is announced elsewhere) will eclipse it with 27.35' miles of tile and .64 miles open cut, and will drain 3,500 acres, of which 1,200 acres will be fully tile drained.

EAST ORANGE SEWERAGE.—The Township Committee of East Orange, N. J., has, after several years of investigation, adopted the plans of Mr. C. A. Bassett, C. E., of Newark, for a separate system of collection and purification locally by chemical precipitation, followed by intermittent downward filtration through about ten acres of land. This is a radical departure from present practice in sewage disposal, and its results will be watched with interest. The sewerage work is now advertised in our advertising pages, and the contract for the purification works will shortly be open for bids, the plans being now in preparation. It is expected that the entire system will be in working order by the first of next year.

BROOKLYN'S WATER SUPPLY.—Water Purveyor Hawkes has stated that during the first week of August the city was using 45,500,000 gallons per day against 43,000,000 last year. Although there had been plenty of rain the maximum supply is only 50,000,000, and another year would, under the same conditions, find the city trenching on its resources. City Engineer Van Buren stated that the detailed plans of the water extension would be ready in a few weeks, and that the city would probably suffer for it if the Board of Aldermen did not take prompt action. It would take three years to complete the extension, and the shortest space of time in which any addition to the present supply could be had from the extension was a year and a half. September of this year, coming after the ordinary August drought, will probably be a trying month.

BATTLE CREEK, MICH.—W. W. Brigden, Chief Engineer, informs us that the above city has received proposals for water-works from the following firms:—Edgar Williams, Chicago; Moffett, Hodgkins & Clarke, Watertown, N. Y.; Turner, Dellaway & Rawson, Boston, and MacRitchie & Nichol, Chicago, Ill. The latter firm has been awarded the contract at a total cost of $160,000. The specifications call for two Blake compound, duplex, pumping engines of one and one-half million gallons each in twenty-four hours; a stand pipe 75 feet high and 10½ feet diameter; ten and one-half miles of cast-iron mains from 4 to 16 inches; a brick engine and boiler house and about ninety hydrants. The supply is to be taken from Lake Gognac, which has an area of about one-half of a square mile and is 75 feet deep; situated two miles from the city. The stand pipe gives a 200 feet head to the business portion of the city and 75 feet above the highest house. Work is to commence within 30 days.

NEWS OF THE WEEK.

Contracting.

Wanted.—Information respecting the whereabouts of the American Construction Company, late of 98 Randolph street, Chicago, Ills. Address this office.

Soldiers' Monument for Cass Co. Ind.—The Commissioners of Cass Co. Ind., will receive sealed proposals at the Auditor's Office in Logansport, in that county, until Sept. 28, 1886 for the erection of a Soldiers' Monument in Logansport. The plan is now on file at the office named and the contractor is to furnish all material and do all work of excavation, foundations and erection of monument. Specifications will be furnished by Harry Torr, Auditor, Cass Co. Indiana.

The Manchester Ship Canal.—A contract has been made to complete the Manchester Ship Canal in four years from the date of beginning actual operations. The cost will be $28,750,000. This includes cutting the the canal, building docks at Manchester and Warrington, constructing locks and a swing aqueduct at Barton. Some 20,000 men and 6,000 railroad wagons will be employed on the work. The canal will be thirty-four miles long, 26 feet deep and 120 feet wide. There will be four sets of locks adapted both for the largest merchant vessels and the smallest craft. The contractors are Messrs. Lucas & Aird, London

The New Croton Aqueduct.—The books showing the financial transactions of the Aqueduct Commissioners from October, 1883, to August, 1886, have been examined by the Commissioners of Accounts, and found to be correct. The books were devised by, and kept under the immediate direction of the late Secretary, James W. McCulloh. The expenditures for all purposes were as follows:

Expenses Commissioners office	$135,241.80
Expenses Commissioners of Appraisal	162,514.14
Expenses Engineers	388,272.21
Expenses Croton Lake survey	34,776.42
Expenses new reservoir	10,118.88
Land, land damages, etc.	49,112.64
Taxes on lands	401.25
Expenses land agents	828.65
Expenses Diamond Rock borings	7,077.42
Purchase of rock boring drills	44,546.08
Monumenting line	3,674.98
Monumenting tunnel	140.70
Models (blow-offs)	225.00
Observatory towers	1,805.95
Soundings south of One Hundred and Thirty-fifth street	931.10
Traveling expenses of examining engineers	1,815.64
Extra work on Section No. 14	537.49
Contracts, construction	4,330,252.19
Agreements under section 33, chapter 490, Laws of 1883	12,241.67
Total	$5,174,574.31

American & Mexican Pacific R. R.—Under a contract with the Mexican Department of Public Works, the Texas, Topolobampo and Pacific Railroad and Telegraph Company has obtained some important modifications of its original concessions for a railroad from Topolobampo, on the Pacific, to Piedras Negras, on the Rio Grande. Under the new arrangements construction has to be commenced within sixty days after the approval of the plans by the department. The company may begin at either end, but is bound to keep up construction at the rate of two-thirds on the east and one-third at the frontier, and to finish every two years at least 100 kilometres of main line and branches. It is optional with the company whether Topolobampo or Mazatlan is to be the terminus of the main line. The whole line and branches are to be completed within ten years. The subvention clause gives the company a large free list of railway material, etc., to be in force for fifteen years, and a rebate on further importations for the road's use, not to exceed $25 annually for each kilometre in actual operation, settlement to be made every two months.

By Tunnel from Sweden to Denmark.

Copenhagen Letter to the London Standard.

Mr. Alexandre de Rothe, an engineer, who has been working at Panama under M. de Lesseps, has presented to the governments of Denmark and Sweden a project for a submarine railway tunnel under the Sound between Copenhagen and Malmo. The tunnel is to have a total length of 13 kilometres, three between Ameger and the small island Saltholmen, under the Strait Drogden, and nine between Saitholmen and Sweden. The ground to be worked much resembles that in the channel between England and France, and is said to offer no difficulty to the execution of the work. The cost of construction is calculated to amount to 30,000,000f., or £1,200,000. The Swedish Government takes a great interest in the plan, while the Danish at present is keeping somewhat back. Mr. de Rothe entertains sanguine hopes of a successful result of the negotiations. The tunnel would be of the greatest importance for the future commercial connection between Sweden, Norway, and later on of Russia, and the whole continent, as laden railway wagons could then run from the north of Norway, Sweden, or Finland, down to the south of Italy.

Contractors Intelligence,

Reported by T. H. Boorman.

Engineering and Building Materials.

WHOLESALE PRICES.

New York, August 19, 1886.

IRON.

STRUCTURAL IRON.			
Angles		1.95c @	2.10c
" steel		2.35 @	2.45
Tees		2.35 @	2.45
Beams and channels, American		3.0 @	
Tank plates		2.10 @	2.20
Shell plates		2.4 @	2.5
Steel plates, Tank		2.70 @	2.75
WROUGHT-IRON PIPE. PITTSBURG.			
Butt welded, black	Discount		45
" galvanized	"		35
Lap welded, black	"		60
" galvanized	"		42½
Boiler tubes	"		52½
RAILS.			
Steel (large lots at mill)		$34.00 @	$35.00
Old rails		19.50 @	20.00
Old rails, steel		22.00 @	23.00
R R. spikes			2.40c
R R. splice-plates		1.80 @	2.00
R R. track bolts, square nuts		3.00	
Barb-wire fencing, galvanized		4.00 @	4.38
" painted			4.00
Corrugated iron			
Nails			
Iron, per keg		2.15	
Steel do.		2.20 @	2.25

METALS.

COPPER.			
Lake Superior		10.25 @	10.38
Other Brands		₱8.25 @	9.75
LEAD.			
Com. Domestic		4.75 @	4.80
Lead Pipe		.06¼c.	
Tin-Lined Lead Pipe		.15	
Sheet Lead		.07¼	
ZINC.			
Sheet		5.60 @	5.85

BRICK.

Cargoes (afloat)			
Choice Brands		7.25	
Haverstraw	per M.	6.25 @	7.00
Fishkill			6.25
Up-River		5.50 @	6.25
Jersey		5.50 @	6.00
Long Island			
Pale		4.50 @	4.75
FRONTS.			
Croton, red		11.00 @	15.00
" dark		11.00 @	15.00
" brown		10.00 @	14.00
Philadelphia pressed		27.00 @	28.00
Trenton "		25.00 @	26.00
Baltimore "		37.00 @	41.00
Buff "		33.00 @	35.00
Enameled English		85.00 @	130.00
" American		80.00 @	120.00
Fire brick		25.00 @	55.00
" American, No. 1		30.00 @	35.00
" " No. 2		25.00 @	30.00

ASPHALT.

ROCK.			
French		$20.00 @	25.00
German		15.00 @	20.00
According to quantity or brand, and whether taken from vessel or store.			
PAVEMENT.			
Barber's Asphalt		$2.50 @	$3.00

LIME.

Rocklock Cement Co.'s Ground	.80
Rockland, common per bbl	1.00
" finishing	1.20
State, common	.85
" finishing	1.05
Kingston, ground	.90
Add 25c. to above figures for yard rates.	

STONE.

Cargo rates at New York.

Amherst freestone, No. 1	per cub. ft.	0.95 @	1.00
" " No. 2	"	0.75 @	0.85
" " light drab	"	0.80 @	0.95
Berlin " in rough	"	0.75 @	1.00
Beren " "	"		
Brown stone, Portland, Ct.	"	1.00 @	1.35
" Belleville, N. J.	"	0.75 @	1.35
Granite, rough		0.45 @	1.25
Common building stone per load		2.00 @	3.00
Base stone, from 2½ to 6 ft. lengths, per lin. ft.		0.40 @	3.00
Concrete and macadam stone, Tomkins Cove, per cub. yd			$1.65

SLATE.

Purple roofing	per square	6.00 @	7.00
Green	"	6.00 @	7.00
Red	"	15.00	
Black Penna. (at New York)	"	4.50 @	5.00

LUMBER.

Prices for yard delivery in New York.

PINE, Common box	per M.	18.00 @	20.00
Choice	"	65.00 @	70.00
Tally plank, 1¼ in.10 in. dres'd, each.		.44 @	.50
Tally boards, dressed com.	"	.28 @	.30
SPRUCE, Boards dressed	"	.25 @	.28
Plank, 1¼ in	"	.28 @	.30
" 2 in.	"	.38 @	.40
" 2 in. dressed	"	.42 @	.45
Timber	per M.	13.00 @	16.00
HEMLOCK, Boards	each.	.18 @	.20
Joist, 2¼ × 4 to 4 × 6 in		.16 @	.44
OAK	per M.	55.00 @	65.00
CYPRESS 1, 1¼, 2 and 2¼ in	"	35.00 @	40.00
YELLOW PINE, Girders	"	25.00 @	30.00
Dressed flooring	"	28.00 @	35.00
SHINGLES, Extra shaved pine, 16in.	"		
" sawed 18 in.	"	5.75 @	6.00
LATH, Cargo rate	"		2.10

PAINT.

Lead, white, American dry	per lb	.04¾ @	.06½
" " in oil pure	"	.07 @	.07½
" English, B. B. in oil	"	.08¾ @	.08¾
" Red, American	"	.06½ @	.07
Litharge	"	05¾ @	.06
Venetian red, American	"	.01 @	.01¼
Indian red	"	.08 @	.10
Vermillion, American lead	"	.10¼ @	.11½
Paris green	"	.15 @	.18
Umber, Amer. raw and powdered	per lb.	.01¼ @	.01¾
Drop black, Amer.	"	.07 @	.13
" " Eng.	"	.11 @	.13
Chrome green	"	.10 @	.25
Oxide zinc, American	"	.03½ @	.03¾
" French	"	.06½ @	.07¼

CEMENT.

The following price current is made up entirely from quotations furnished us directly by the firms dealing in each brand; the prices are understood to be wholesale in New York, subject to such special rates as large quantities may warrant:

CALVIN TOMKINS:		
"Old Newark Co's." Cement		$1.10
BAETJER & MEYERSTEIN:		
Hanover Portland	$2.00 @	$2.65
BELLONI & Co.:		
Hemmoor "Crown" brand		2.50
JAMES BRAND:		
Burham	2.25 @	2.50
Fewen	2.25 @	2.50
BROOKES, SROOBRIDGE & Co.	2.45 @	2.60
HOWARD FLEMING:		
Gibbs' English Portland, 400 lbs	2.50 @	2.75
K. B. & S. " "	2.25 @	2.50
Stettiner, German	2.65 @	2.85
Lagerdorfer, "	2.45 @	2.75
Fleve, A 1, Belgian	2.35 @	2.50
Roman	2.75 @	3.00
Keene's Coarse	4.75 @	5.50
" Fine	7.75 @	8.50
" Superfine	8.50 @	10.00
FISHER, ERSKINE W.:		
Stettin (German) Portland Cement	2.40 @	2.75
GABRIEL & SCHALL:		
Vorwohler "Lion"	2.65 @	3.10
HUDSON RIVER CEMENT Co., Rosendale		0
JOHNSON & WILSON:		
Saylor's American Portland	2.15 @	2.45
LESLEY & TRINKLE, Philadelphia, Pa.:		
"Giant" Portland	2.20 @	2.40
Improved "Union"	1.25 @	1.50
Union	1.10 @	1.20
MARCIAL & Co.:		
J. B. White & Bros. Coarse Keene's	4.25 @	4.50
" Superfine	7.25 @	7.50
" Portland	2.65 @	3.00
NEW YORK CEMENT Co.:		
Rosendale		1.10
N. Y. & ROSENDALE CEMENT Co.:		
Rosendale, "Bridge" brand		1.10
SINCLAIR & BAUSON:		
Alsen's Portland Cement Works	2.35 @	2.85
K. B. & S.	2.25 @	2.50
STANDARD CEMENT Co		
E. THIELE:		
Dyckerhoff	2.90 @	3.25
UNITED STATES CEMENT Co.:		
English Portland	2.25 @	2.40
German "	2.00 @	2.15
Standard	1.80 @	1.65
Windsor and Improved Rosendale	1.00 @	1.10
UNION AKRON CEMENT Co.:		
Akron "Star" brand	1.00 @	1.10

MARKET SUMMARY.

Building materials generally show virtually no change in prices this week. The Brick market is precisely as last week, no change in quotations and a fair demand for good quality, manufacturers seem satisfied with ruling prices, are working full capacity, and shipping along at their convenience. Cement moves slowly for Rosendale brands, and we hear of sales at 90 cents per barrel, favorite brands $1.00 @ $1.05 per barrel for immediate delivery, $1.10 the regular quotation. Foreign cement does not appear to drag on the market and most of the importers sell their importations before arrival. The sale of 20,000 barrels for use on the aqueduct "previously mentioned" is now statedto be of "Whites" English, although it is claimed the purchase had been previously closed for "S ylors" American. The Lumber market is fairly active and prices on Spruce are well held. Pine also is in good demand at last week's quotations. Lath is commanding slightly better figures in consequence of light arrivals, and is now held at $2.10 per M. Lime owing to the temporary suspension of shipments from Maine is getting scarce, but arrivals are anticipated shortly, the prices are still $1.00 per barrel for common, $1.20 for finishing, with no probability of a change. Plaster is in fair demand at $1.20 @ $1.25 for ordinary city, orders for export and interior orders about equal to last year. The Paint and Oil market shows no change with the exception of Turpentine which is higher, 35½ cents being the lowest quotation, a healthy trade generally reported. The Hardware market is without special features. Nails are still quoted at $2.10 @ $2 20 per keg. Pig Tin has not kept up the advance, the market having weakened in London and sales of Straits are reported here at $21 95 per ton. Tin Plates are quiet with a limited demand and no break in prices. Lead has been reported sold at c.4.75, with c.4.80 asked. There is a good demand for stone, the extensive use of Terra Cotta has somewhat affected the call for the more expensive qualities, but the quarries do not make any complaint of lack of orders.

BUILDING ITEMS.

Augustus Hatfield, No. 2 Stone street, has completed the plans for the new hotel to be built for Mr. Louis Todd, on the northwest corner of Broadway and Thirty-sixth street. The building will be six stories high, of brick, with blue stone trimmings, and frontages of 145 feet on Broadway and 139 feet on Thirty-sixth street. The cost is estimated at $250,000, but contracts have not yet been awarded.

The Board of Health, on Tuesday, awarded the contract for the erection of two frame pavilions on North Brothers Island to Mr. Chas. B. Trimble. The plans were drawn by Mr. Jos. M. Dunn.

Mr. Wm. E. Worthen, 63 Bleecker street, has been appointed engineer to prepare the plans for the new Mount Vernon sewer.

J. D. Karst, Jr., will build on the south side of Sixtieth street, 100 feet west of Tenth avenue, three five-story flats and stores at a cost of $54,000

Mr. H. C. Blanchard, architect, reports excavations commenced for the extensive addition to be made to the residence of Mr. Benj. Lewis at the corner of Lafayette and Cortlandt avenues, Brooklyn.

The Consolidated Stock and Petroleum Exchange, are considering the feasibility of erecting a $200 000 building at Nos. 58 to 62 Broadway, but as the property is only leased for a certain number of years the matter has not been fully decided on.

Mr. Paul F Schoen has drawn the plans for the building to be erected on Twelfth avenue, from Forty-second to Forty-third street, to replace the car depot and stable of the Forty-second and Grand Street Ferry Railroad Company, the building will be of brick with gravel roof, three stories high and will cost $160,000.

Mr. E. W. Gross is in the architect for alterations and an extension to be made to No. 226 Stanton street, at a cost of $15,000.

Messrs. E. A Sargent & Co. have drawn plans for a $25,000 residence, to be built at Mamaroneck N. Y., for U. D. Eddy.

Mr. Wm. H. Mercer-au reports estimates now being received for a barn, stable and carriage house, 98 by 88, with extension 20 by 56, to be built for Messrs. D. & E Roberts, at Elting ville, Staten Island.

Mr. Jos. M. Dunn reports plans on the boards for a residence to be built at Far Rockaway, near Wave Crest, for Mr. Thomas Boyne, it will contain all modern improvements, and be lighted by gas. The cost will be about $12 000.

Mr. W. Holman Smith, 28 West Twenty-third street, reports alterations to be made to No. 34 West Thirtieth street, turning the building into a store, and connecting it with the Gilsey House Annex, cost of the improvement will be about $6,000. He is also the architect for the rebuilding of No. 112 West Twenty-ninth street, which is to be a five-story single flat house, 24 by 81 front, brick with Scotch redstone trimmings, tin roof, cost of improvement about $15,000. He also reports work commenced on a cottage to be erected for Mrs. Curtenius at New Rochelle, cost about $6,000.

Mr. Lawrence J. O'Connor reports that he has prepared plans for rebuilding the church of the Immaculate Conception at Amenia, Dutchess county, N. Y. The new edifice is to be of rough native stone and timber, with slate roof, and shows a unique design. Cost about $10,000.

Mr. Geo. A. Freeman, Jr., 149 Broadway, reports designs on the boards for a first-class hotel; 300 feet front, which, with twelve cottages, is to be built on thirty acres of land on Long Island near the ocean, for a stock company.

Mr. Thomas E. Tripler, of Avenue B and Eighteenth street, will build on the site of the old New York Mastic Works, on the south west corner of Avenue B and Seventeenth street, eight five-story tenement houses, brick and stone, tin roofs, at a cost of $140,000.

Soda Locomotives.

From the Philadelphia Record.

At the Baldwin Locomotive Works there are in course of construction four locomotives which are designed to be run by soda, which takes the place of fire under the boiler. Soda has much the same power as coal without any of the offensive gases which that fuel emits. The engines are now nearly finished, and are to be shipped within two weeks to Minneapolis, Minn., and are to be run on the streets of that city, where steam engines are forbidden.

The engine has much the same appearance as a passenger car. It is about 16 feet long, entirely boxed in, with no visible smokestacks or pipes, as there is no exhaust or refuse. The boiler is of copper, 84½ inches in diameter, and 15 feet long, having tubes running through it, as in steam boilers. Inside the boiler will be placed five tons of soda, which, upon being dampened by a jet of steam, produces an intense heat. When the soda is thoroughly saturated, which will occur in about six hours, the action ceases, and then it is necessary to restore it to its original state by forcing through the boiler a stream of superheated stream from a stationary boiler, which drives the moisture entirely from the soda, when it is again ready for use. The exhaust steam from the cylinders is used to saturate the soda, and by this means all refuse is used.

These engines are the first of their kind that have been built in this country, and are being constructed under the supervision of George Kuchler, a German engineer. The engines will have about the same power as those on the New York elevated roads and will readily draw four light cars. Soda engines are now used in Berlin and other European cities very successfully.

Railways of the World.

According to statistics recently published in a German journal on the railway enterprise of the world, the aggregate mileage at the end of 1884 was 290 750 miles. Europe claimed of this total 117,694 miles; Asia, 12,787; Africa, 4,675; America, 148 738; and Australia, 7,486 miles. Not less than 60 per cent. of the whole mileage o. the world is in English-speaking countries. Australia has the largest amount of railway accommodation in proportion to population, and the United States and Canada come next. The cost of constructing the universal railway system is estimated at £4 800,000,000. The highest expenditure was in Great Britain, where it amounted to £41 166 per mile, as compared with £34,797 in Belgium, £34,926 in France, £21,041 in Germany (State railways), £20,965 in Austria, £16,449 in Russia, and £12,600 in the United States,

Mount this map so it will
show fairly

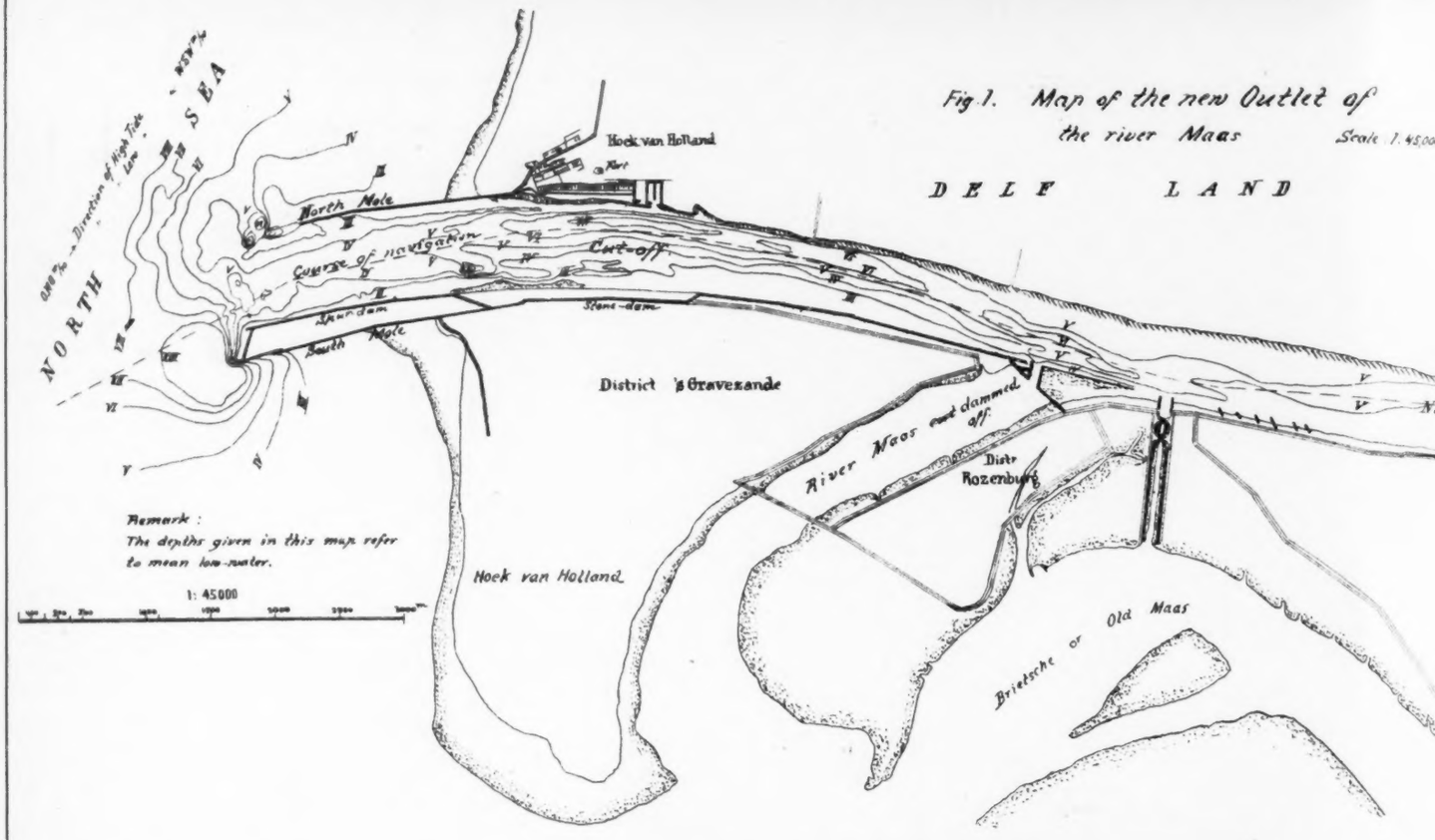


Fig. 1. Map of the new Outlet of the river Maas Scale 1:45000

New Channel from Rotterdam to the North

The measures are given in feet, except where differently marked. m means meter.

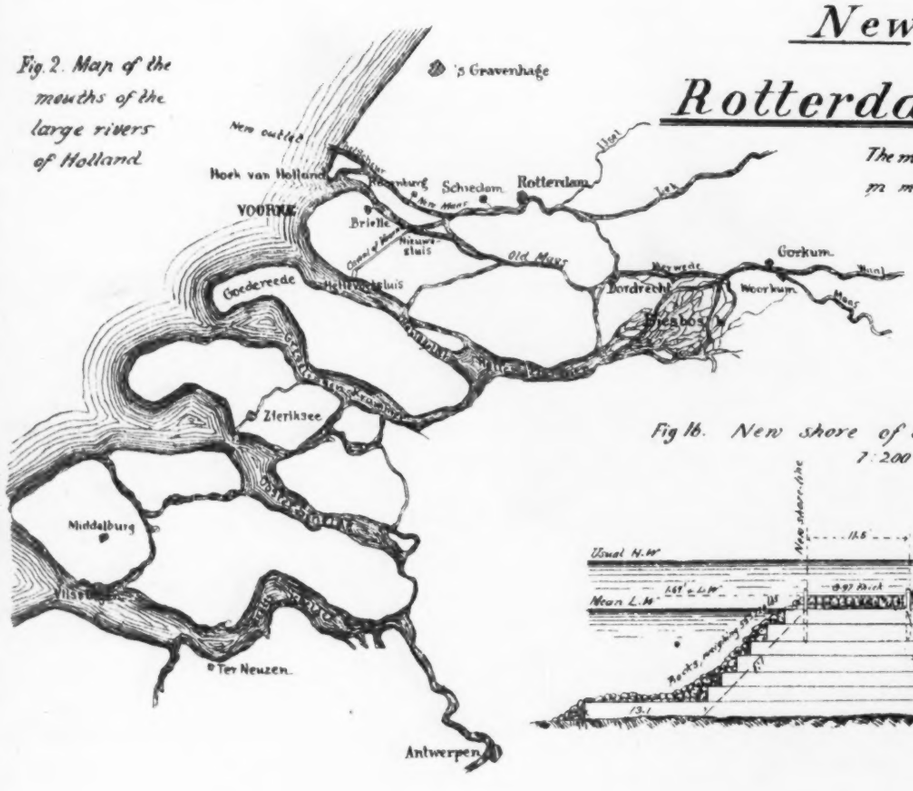


Fig. 2. Map of the mouths of the large rivers of Holland.

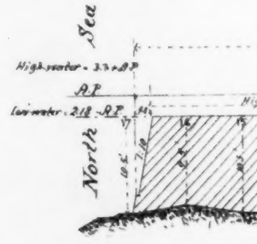
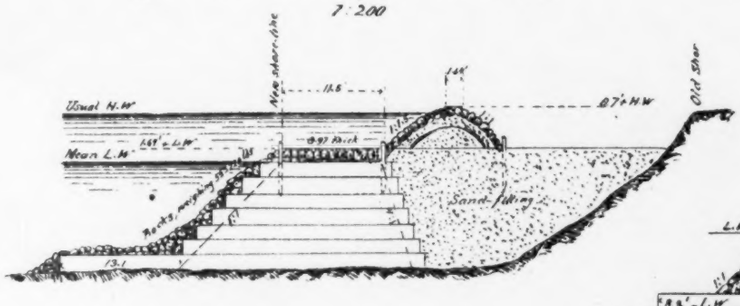


Fig 1b. New shore of the lower Maas. 1:200



Scales . 1:200

1:400

1: 10.000

Fig.

Fig 3. Enlargement of the end of the North Mole (scale 1:400)

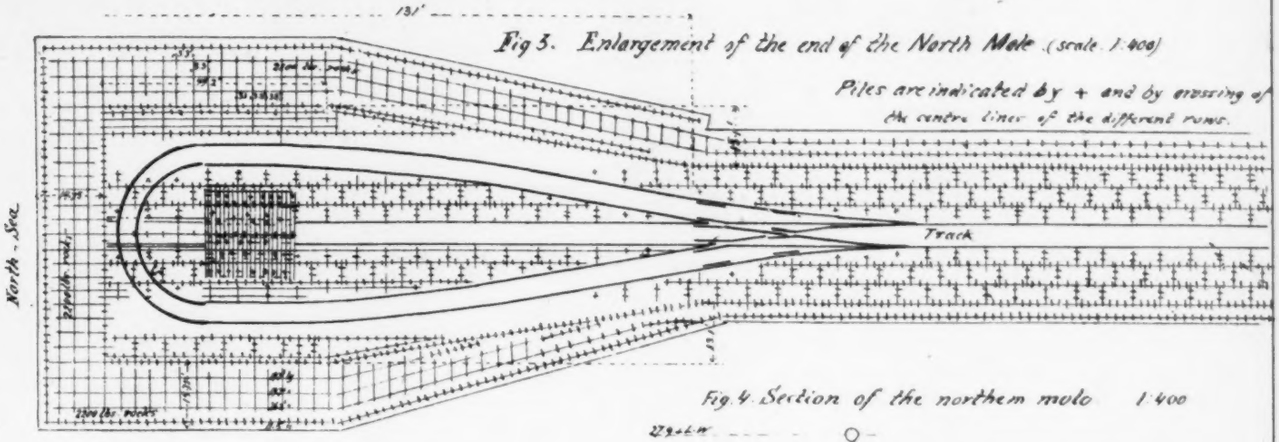


Fig 4. Section of the northern molo 1:400

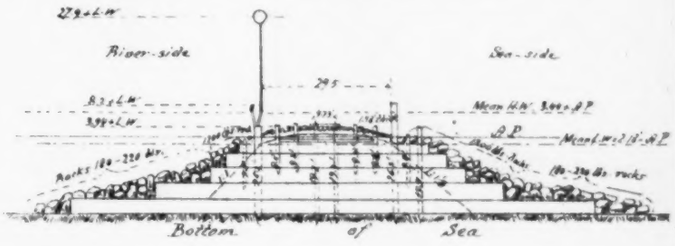


Fig 5. Section of the southern molo. 1:400

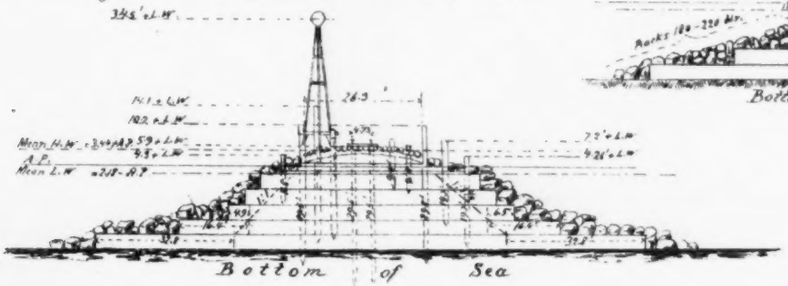


Fig 6. Arranging the rocks for the crest of the dam.

rth-Sea.

Fig 7-15. Spur built to reduce the width of the river.

Fig 7. Profile of the low dam between the proper harbor-dams, to narrow the entrance

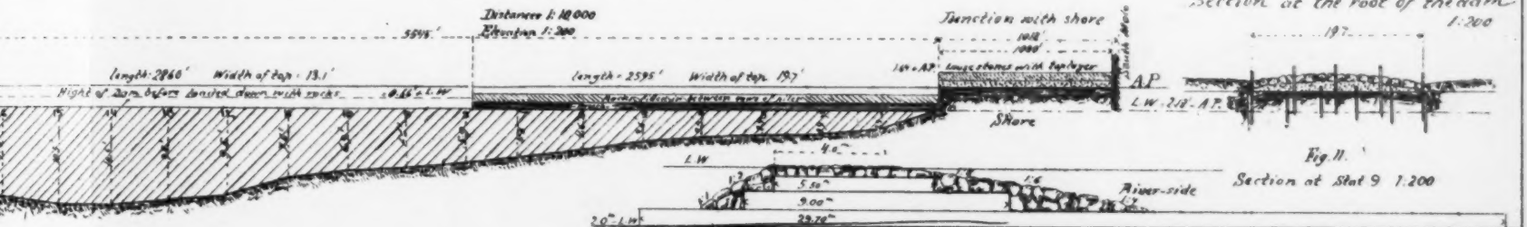


Fig 8
Section at the root of the dam 1:200

Fig 9
Section at stat. 6+50 1:200

Fig 10. Section at stat. 4. 1:200

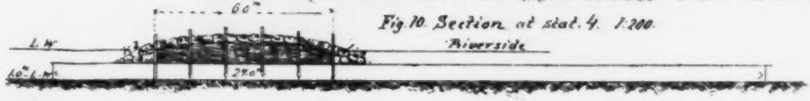


Fig 11.
Section at stat 9 1:200

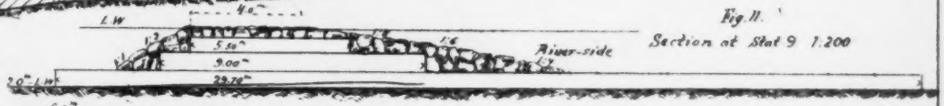


Fig 12 Section at stat. 11+30 1:200

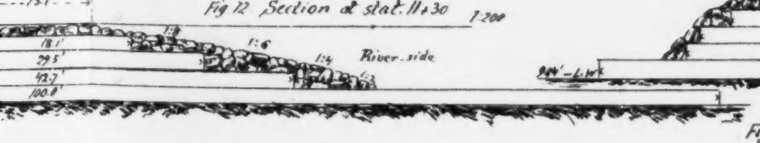


Fig 13. Section at stat. 13 1:200

Fig 14. Section at stat. 15+60. 1:200

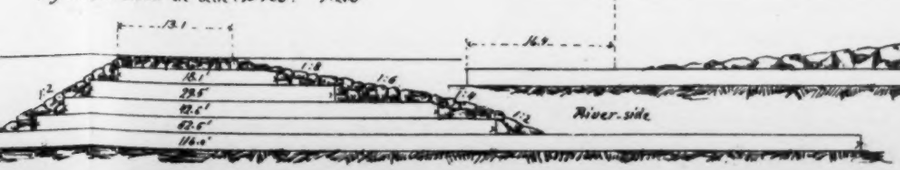
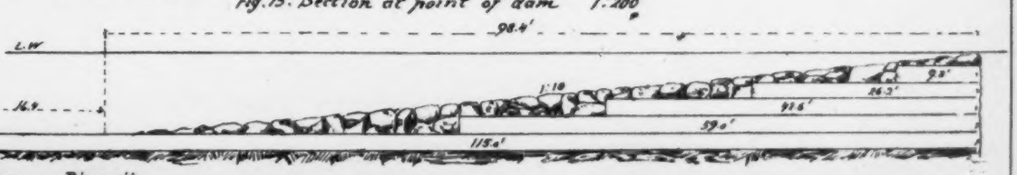



Fig 15. Section at point of dam 1:200